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Getting the Most Out of Your Machine Tool Dollar

By Wm. Hartman
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There was a time when we followed the policy of insisting that a machine, to justify its acquisition, must pay for itself within one year. It is a policy to which we did not adhere. We found that many innovations would not have happened had we done so. There is no stated time at which new equipment is to be bought. We are open every day in the year to suggestions and one day is just as likely as another to witness the placing of orders for equipment

SOMETHING of our organization should be known as a background against which to sketch our equipment policies. That is necessary because the equipment and the people who use the equipment, the two divisions in our plant that make our production possible, must be truly efficient, on the one hand, and, on the other, thoroughly in phase with their work.

To quote from one of our publications, "This company has gone forward under the conviction that success cannot be won by developing machinery and neglecting men, that there are human values as well as machine values. Therefore a premium has always been put on that method of production which secured the maximum output with the greatest possible protection of the employee's health and life."

In visualizing the magnitude and importance of the equipment problem of the National Cash Register Co., it should be kept in mind that more than 4,000 machine tools are distributed among buildings containing 47 acres of floor space, with driving units totaling 8,900 horsepower and with 10,680 ft. of conveyors. The production is 600 cash registers per day. During the five-year period, 1919-1924, an average of 150 machine tools was bought yearly. Tables I and II show, respectively, the classifications and quantities of production machines in our plant and an average replacement program for one year.

Our personnel policy, the physical aspects of the plant, the fact that machine rooms are served by conveyors, of themselves affect our procedure in acquiring and using equipment, as well as influence the selection of men to look after equipment problems and the assignment of their duties.

That part of our organization controlling the acquisition of equipment for production is made up of the superintendent, supervisors, the efficiency engineering department, foremen, and job foremen. The job foremen are responsible for the production of certain parts, or "jobs." They report to the foremen, who are responsible for the production of groups. The foremen report to the supervisors, who are responsible for the production of a number of groups. The supervisors report to the superintendent, to whom the efficiency engineering department also reports.

In spite of the difficulties indicated, we think that we are handling our equipment problem efficiently, though simply. Perhaps I should say that our methods are efficient because simple. We have always favored a direct way of doing things.

Every job foreman, foreman and supervisor has the privilege of making a request for machinery that he thinks would improve method or product, reduce cost or conserve floor space. To keep responsible heads of departments acquainted with everything going on, it is the routine for such requests to pass from the originator to the next superior, a routing very desirable for the sake of discipline.

The possibilities that a suggestion will be turned down, tabled, or killed, by a superior, are minimized by the direct contact of the efficiency engineering department with all heads in the production departments. They are further reduced by the weekly meetings of foremen and supervisors, presided over by the superintendent, wherein the utmost freedom of speech is permitted, and equipment proposals of even the most "radical" nature are discussed. These meetings, because of the broad policy in their conduct, have been productive of some "wild ideas" that have been real money savers. Men who originate ideas that will not work out are not penalized, by ridicule or otherwise. They are shown why their plans are unsound, impracticable or uneconomical.

At the risk of seeming to overemphasize our faith in the possibilities of suggestions from the men in daily contact with the job, I want to refer to an example of a result attributable directly to the suggestion system and for which the man conceiving the idea was paid a major prize.

In graining the outside surfaces of certain metal parts of cash registers it is necessary to wash the composition transfer rollers after each impression. Formerly they were washed with benzine rags and then rubbed clean with dry rags. One of the men on the job suggested that a benzine tank be furnished, arranged to support the graining roll on either end. This device would allow the men to rotate the roll in benzine by hand, drying it by the old method of wiping with rags.

Table I—List of Machines in Use at the Plant of the National Cash Register Co.

Die casting machines	11
Drill presses	799
Engraving machines	42
Gear hobbing machines	10
Grinders—casting, center, cutter, centerless, others	312
Lathes	369
Milling machines	614
Miscellaneous machinery	1,229
Planers	10
Printing presses	65
Profilers	79
Punch presses	251
Riveting machines	66
Screw machines—automatic	461
Screw machines—hand	97
Shapers	25
Tapping machines	78
Woodworking machinery	146
Total	4,664

The efficiency engineering department developed from his suggestion the apparatus that we now use. It consists of the two rolls to apply the benzine and two sets of rolls, cloth covered, for drying the rollers. Our object in using two sets of drying rolls is to make the machine double-ended, so that a roller can be dried at each end of the machine after being wet on the two benzine-applying rolls at the center. The savings on rags and benzine have been more than worth while and expense has been saved even on rollers, because they deteriorate much less rapidly under the present drying method than when rubbed with rags.

I have not digressed from the equipment story in describing this suggestion and the sequel. The example was not of a machine tool, but we have valuable suggestions that involve machine tools and it is no exaggeration to say that a man in the shop may quite unwittingly sell a machine tool without the maker's ever having the least suspicion of the origin of his order.

To get back to the procedure of selecting, and finally of ordering, machine equipment. I have said that each of the production heads passes his suggestions along to the next higher head. That is true until the supervisors are reached. They, instead of passing their suggestions to the superintendent, to whom they report, give them to the efficiency engineering department. Being made up of men thoroughly experienced in design and in the possibilities of equipment, this department is able, without waste effort, to analyze the proposals and to make definite disposal of them. They endorse them, sending the endorsement to the superintendent for OK; recommend further investigations by the supervisors; recommend deferred action, for example later purchase; supply the equipment from some other department where it is no longer needed; or reject the proposals. Reasons for rejection, when requests are so disposed of, are given to the originators of the requests.

Investigations of all requests, as thorough as necessary, are made. When suggestions involve radical changes or unusual expenditures, disposition of them sometimes is not made until after analysis by the combined forces of superintendent, efficiency engineers and supervisors concerned.

The efficiency engineering department, in addition to passing upon the suggestions of others, is, of course, carrying on its primary duties of finding more efficient methods and equipment and of designing machinery not available on the market.

It is a department that is continually seeking, finding, sorting, classifying and using equipment information. It has files of catalogs and data that are essential in its work. It receives the technical magazines, is in touch with machine tool salesmen, and sends its representatives to machinery expositions and to other plants. Its decisions are impartial and are based on facts. But with all due respect to the importance of facts, such a department cannot be operated by men without imagination. It is to imagination, vision if you will, that we owe many of our improvements, particularly in the development of special machinery.

It is not our policy to make autocrats of individuals or departments. All orders for equipment are placed by the efficiency engineering department, but they are signed by the foreman and supervisor interested and by the superintendent. At almost any stage, until they are actually on the way to the builder, the orders are subject to discussion.

A part of the equipment information available is a card index record. The data obviously needed are recorded: type of machine, maker's name, location, feeds, speeds, and so on. One of the important functions of the machine record is to serve as a check on the disposal of equipment from one department that can be used in another.

Table II—Average Number of Machines Purchased and Built Yearly for the National Cash Register Co.

Automatic screw machines	26
Drilling machines	29
Grinding machines	14
Milling machines	17
Miscellaneous	58
Printing machinery	28
Punch presses	7
Woodworking machinery	22
Special machines (designed and built by the National Cash Register Co.)	13
Total	214

Before dismissing the subject of the collection and assimilation of information let it be said that there is much in favor of sending shop men to visit other

plants. We send selected groups of foremen and supervisors from time to time. The stimulus to self-confidence and ambition as well as production advances due to knowledge gained are the results of that kind of recognition by management of the human side in industry. The man who will grow at all becomes self-reliant in proportion to the reliance placed upon him.

With this opening wedge, I want to point out certain psychological effects of equipment. There is an effect in the movement of material on conveyors that makes the workers want to keep it moving. That is aside from the human considerations that would prompt the installation of machinery to relieve human beings from the drudgery of heavy loads. There is the same effect from continuous, real production, and from automatic machines, to say nothing of their desirability from an economic point of view, in the more efficient use of labor and in the reduction of consumer prices.

With us there has never been any question when it came to getting equipment to improve either the production program or the conditions of our workers. Nor have we ever had great difficulty in "selling" new equipment to the workers. Perhaps there is some psychology back of that kind of condition.

When a machine has passed through its period of usefulness in the department where it is in service, and there is no other department wanting it, it is sent to the salesroom for used machinery, listed for resale or to be sold as scrap. Machines listed for resale are held only a limited time. If no market has been found at the expiration of that time they are then scrapped

Let me get back to things more definite, the steps in ordering equipment and the disposal of what we cannot use. The originator of a request for new machinery may want an additional machine of a kind already in use, or may want something entirely different from equipment on hand. In either case he fills our a printed form, "Request for Machinery," that is sent, by the routing described, to the efficiency engineering department. This form provides for telling the need for the equipment, the class of work for which to be used, why it is necessary, and when it will be needed. It is signed by the head of the department and the supervisor. Copies are made for the efficiency engineering department, the supervisor, and the head of the department. A form is provided on the back of the efficiency engineering department's copy on which to record certain details in regard to dates of request, quotation, delivery promises, motor details, and so on.

A second form, "Request for Quotation," is filled out by the efficiency engineering department and sent to the purchasing agent. Copies are made for the purchasing agent, division head, and the department requesting the quotation. On the original copy space is provided for listing the quotations received. When the quotations are listed this copy is returned to the efficiency engineering department. There is also provided space for the recommendation of purchase, this part of the form to be filled after the quotations have been received. The request for quotation is signed by the head of the department, supervisor and head of division.

With the selection made, the order is written on the "Order" form, copies going to the purchasing department, comptroller's department, receiving department, superintendent, maintenance engineer, head of department, tool supply department, and efficiency engineering department. The order is viséd by the heads of several departments either as OKs or as indications of the receipt of the information conveyed.

My description of the details of replacement procedure is practically complete. I have still to explain the disposition of used equipment and to mention several other points. When a machine has passed through its period of usefulness in the department where it is in service, and there is no other department wanting it, it is sent to the salesroom for used machinery, listed for resale or to be sold as scrap. Machines listed for resale are held only a limited time. If no market has been found at the expiration of that time they are then scrapped. The department head, or supervisor, under whose control the machine has been operating, is the man who decides that the machine is to be disposed of. When he has determined whether it is to be resold or scrapped, and has notified the efficiency engineering department, his obligation to that machine is finished.

Whether a machine that is not giving the best service is to be retained or discarded depends upon what is available on the market to take its place, and upon the extent of repair or overhauling necessary to renew its production efficiency. The repair problem belongs to the foreman of the department using the machine and the repair work is executed under the direction of the foreman of the general machine department, who handles the maintenance of machinery.

An appreciable amount of overhauling is done. The equipment is held to a high standard of condition, and is used carefully. We will not overload our machines, believing that overloading is a practice responsible for much of the discontent concerning machine tools expressed by some users. Our policy of not overloading is adhered to with special care in operating our punch presses. We do not have much unfavorable criticism of machine tools. It is our experience that if they are not overloaded and the proper attention is given to oiling and maintaining them, they will give all of the service that should be expected.

Our scheme of power transmission is the group drive, except on heavy machine tools, most of which are driven by individual motors. We have no set ideas concerning ball bearings. In our own design we sometimes use them and sometimes not. On an engraving machine we eliminated bearing troubles due to high speed by applying ball bearings to the spindles. We have been successful in securing what we wanted in a speed lathe, largely because of ball bearings on the spindle. We do not decry innovation and have benefited greatly because of our open-minded policy.

Special machinery is one of our big requirements. When production requirements become so big that standard equipment will no longer take care of them, we

have to get special machinery built or build it ourselves. We prefer to have the machine tool builder do the work, but find that he is reluctant to undertake it unless the proposed machine follows the familiar types. I have no doubt that there are good and sufficient reasons back of his attitude. I am not finding fault, but I do regret that these conditions prevail. I realize that the market for the types of special machines used by us is very much limited.

To conclude, I want to get back to general policy, with which I began the article. There was a time when we followed the policy of insisting that a machine, to justify its acquisition, must pay for itself within one year. It is a policy to which we did not adhere. We found that many innovations would not have happened had we done so. There is no stated time at which new equipment is to be bought. We are open every day in the year to suggestions and one day is just as likely as another to witness the placing of orders for equipment.

[The preceding article is the twelfth under the title, "Getting the Most Out of Your Machine Tool Dollar." The first article, by J. A. Smith, General Superintendent of the General Electric Co., Schenectady, N. Y., was published on page 409, Vol. 62. The second, by C. A. Shaffer, General Supervisor of Machinery and Tools of the Illinois Central Railroad, was published on page 521, Vol. 62. The third, by Robert F. Runge, Vice-president of SKF Industries, Inc., was published on page 719, Vol. 62. The fourth, by L. C. Morrow, Managing Editor, *American Machinist*, outlining the policies of the International Harvester Co., was published on page 793, Vol. 62. The fifth, by G. T. Christopher, Factory Manager, the Dayton Engineering Laboratories Co., was published on page 907, Vol. 62. The sixth, by D. C. Wright, of the H. W. Caldwell & Son Co. plant of the Link-Belt Co., was published on page 1, Vol. 63. The seventh, by T. C. Vail, superintendent, the Spicer Manufacturing Co., was published on page 175, Vol. 63. The eighth, by E. R. Norris, director of works equipment, the Westinghouse Electric and Manufacturing Co., was published on page 255, Vol. 63. The ninth, by Fred H. Colvin, Editor, *American Machinist*, was published on page 417, Vol. 63. The tenth, by Wm. Bailey, production manager, the Hoover Co., was published on page 917, Vol. 63. The eleventh, by G. S. McKee, assistant factory manager, the Timken Roller Bearing Co., was published on page 995, Vol. 63. Other articles on the same subject will be published in forthcoming issues.]

The Works Engineer's Position in Industry

By C. D. Corwin
Works Engineer, Corona Typewriter Co.

TO GET a better understanding of the relation of the works engineer to industry, let us analyze his duties and responsibilities. As the title implies, he is in charge of the plant from an engineering standpoint.

This means considering the entire plant, buildings and equipment as a unit machine which has been constructed with the definite purpose of receiving raw material and labor, combining the two and delivering a finished product. To maintain this unit machine in proper condition, so it can function properly and economically, requires that the buildings which represent the framework of the unit shall be kept in proper condition. For large plants, this is a field in itself and often is treated as a separate department.

Assuming that the buildings are turned over to the works engineer in good condition, it devolves upon him to keep them up to a predetermined standard. Roofs must be periodically inspected and proper treatment applied. Floors must be maintained in good condition. The sanitary conditions must be kept up to a certain standard often prescribed by the state laws.

The conditions under which the labor is to work must be borne in mind, as well as conditions affecting the raw material. The safety of all the various operators must be looked after. In large plants, this is another great field in itself. Too much emphasis cannot be put on safety, for results prove it to be a work that pays from both the humanitarian and the financial side.

In most industrial sections of the country, we find, within the unit machine, a heating system consisting of boilers, pumps, piping, valves, fans, air conditioning apparatus and other appliances. Industry often requires steam for industrial purposes, and this entails another great variety of equipment. Artificial light must be provided, and water is another item that involves many angles.

Machines must be set up for proper sequence of productive operations. Shafting must be installed, direct motor drives connected to power lines. Electric circuits for power and light must be laid out and installed.

There are usually high- and low-pressure steam equipments and piping for various processes. Compressed air, gas lines and refrigeration equipment must often be installed and maintained.

After the unit machine gets under way, the duties of the works engineer have but begun, for a proper force of men must be instructed in the care of the thousand and one things that go to make up the completed unit.

The selecting of the men is considerably different from that for most production departments. In the first case, the work is not located in any particular place. In the case of a production employee, the work is usually localized. The nature of maintenance work is such as to necessitate its being often done after hours.

Requests come to the works engineer for every kind of work that can be imagined and he must meet them with an open mind and courteous compliance. His force of men must be flexible and his various jobs must be performed with a view toward uninterrupted production. In short, the entire machine is a highly sensitive one and but little is required to disarrange its workings.

Seeing Ahead of Trouble

With modern planning systems, any serious interruption in any department is sure to affect the entire production schedule. The works engineer's job is therefore to endeavor to foresee possible breakdowns and to correct the conditions before interruption occurs. His responsibility extends from the foundation of the buildings to the top of the stack. It requires a man with technical and practical knowledge—plus broadmindedness.

It is in this last requirement that many works engineers fail, wholly or in part. An engineer may be well versed in his line and may have been "through the mill" and yet not be selected for a more responsible position simply because he cannot see the other fellow's side. He may not be congenial, or may have trouble with the men reporting to him. Such a man cannot progress as he should, simply because he stands in his own light.

On the other hand, the man putting up a front, dressing up his personality, supervising his vocabulary and stage-managing his conduct can generally make all comers concur with him.

All this may seem superficial, but stop for a moment and think over the men who are forging ahead. You will recall many engineers who had no better knowledge than yourself. Here is the big difference. They could appear before a group of men, present a case, discuss it intelligently and nine times out of ten win the point, while the other fellow, although as wise, is unable to put his ideas across.

Forge Work in a Railroad Shop

By Frank A. Stanley

Some of the tools and methods used in forging bolts of various types, staybolt bushings and boiler checks — Bending hooks for wrecking chains

FORGING practice in the railroad shop is always of interest, as reflecting the advance made possible under modern methods of producing work in quantity under the steam hammer, in the forging machine, in the bull dozer and forging press. Constant effort is being expended in up-to-date shops toward the elimination of unnecessary machine work by the more complete utilization of the forging process, and the attendent application of well-designed tools and attachments for turning out large numbers of forged parts held closely to form and size.

The illustrations reproduced in this article have been selected as showing some of the forging practice in the Southern Pacific Co.'s shop at Sacramento. These views illustrate tools for the production of hexagon- and square-head bolts, tapered crownbolts, staybolt bushings, reversible boiler checks, and wrecking-chain hooks. The first illustration includes sets of combination dies for square- and hexagon-head bolts.

Referring to Fig. 1, the tools will be seen to be complete in the various details. In heading bolts, a common condition found is the forming of fins around the edges of the heads which have afterward to be removed. The tools shown overcome this trouble and the bolts come out of the forging process with smooth corners and with very neat chamfers around the heads.

The bolts are heated with dies *A* and *B*, according to whether the form is hexagon or square, the stock being held in dies *C*. For the finishing of the heads, the slip dies *D* are applied, the work being slipped into

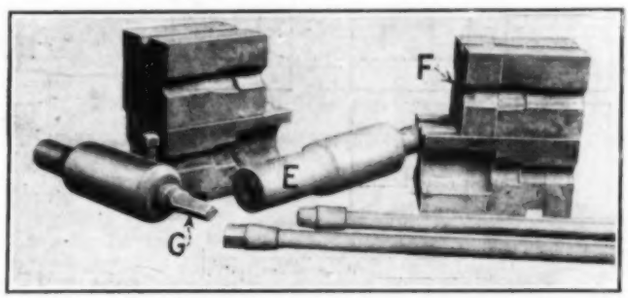

Fig. 2—Dies for forging crown bolts

them for the second operation. The half-hexagon dies upon closing together, swage the fins or burrs into the hot bolt head and leave the sides of the head clean and smooth. At the same time, a flat header comes against the outer end of the bolt head and brings that surface smooth and to form.

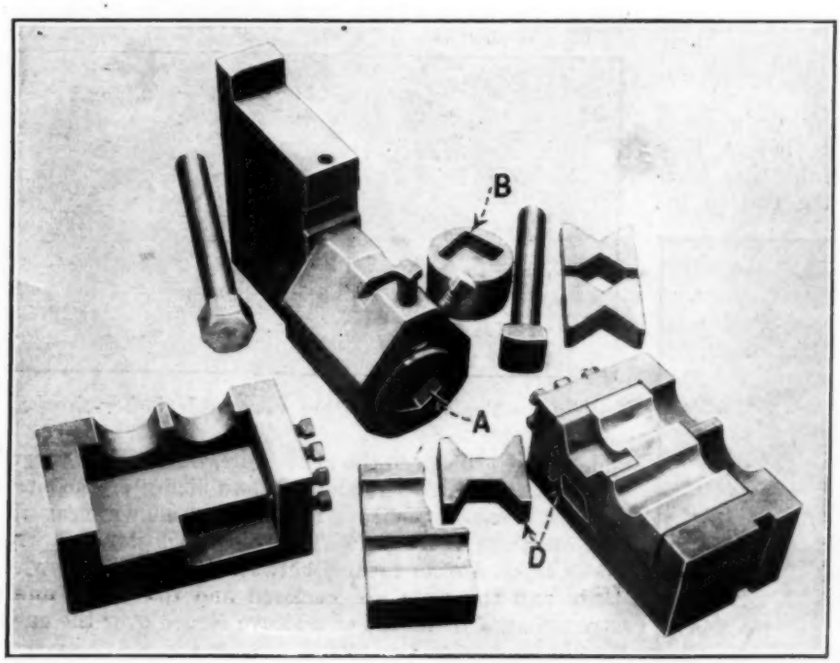

Fig. 1—Heading dies for bolts

The forging dies in Fig. 2 are made for roughing and finishing operations on the tapered portions and the heads of crown bolts. The shape of the first- and second-operation dies will be understood upon inspection of the profiles in the open faces of the half dies. Fig. 3, shows the appearance of the forging after the first and second stages have been completed. Fig. 4 gives complete details of the dies and headers.

The header for the first operation is formed with a working nose, *E*, Fig. 2, 2¾ in. in diameter, so as to enter freely the 2⅞-in. opening in the outer face of the split dies. The outer end o fthe header is bored ⅞ in. diameter and ⅞ in. deep to pass over the end of the hot bar in the dies, and upset the end into the tapered portion which is 1⅝ in. long.

The second blow of the machine carries the header for the second operation into the square die-opening, *F*, and here the tapered neck, as well as the outer end, is forged to size and

length. The squared end of the header *G*, for the second operation, is $\frac{7}{8}$ in. x 3 in. long. The method of securing the header in its holder is by means of a setscrew which bears on the shouldered shank.

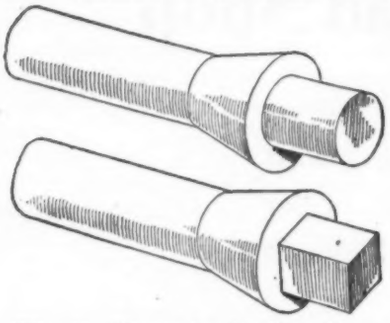

Fig. 3—Stages in forging crown bolts

Staybolt bushings are manufactured in the forge shop by means of the tools illustrated in Fig. 5. The process is analogous to the method of forging nuts, where the end of a bar of hot stock is upset to the form of the nut bodies, and the holes then pierced, thus separating nut blank and bar.

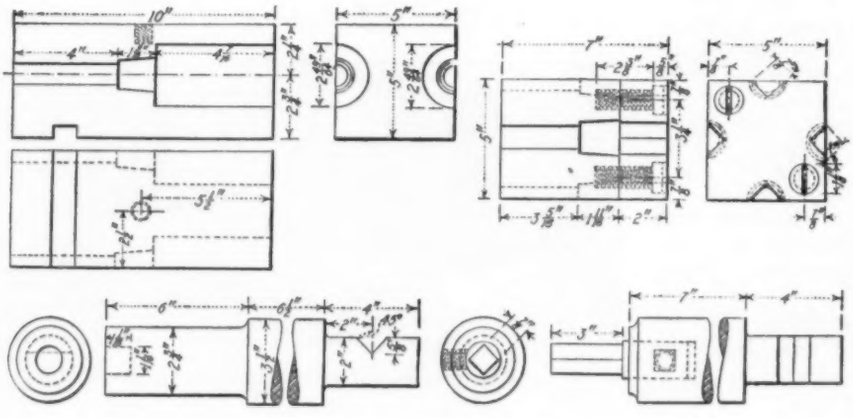

Fig. 4—Details of tools used in forging crown bolts

The staybolt bushing is shown at *H* in Fig. 5. The bar of stock with a blank formed thereon, and ready to be pierced and thus severed from the bar, is lying between the dies. The arrangement of the dies themselves is brought out clearly in the view, enabling their construction to be readily understood without anything in the nature of a detailed description .

It may be observed that the headers or punches enter well into the body of the dies before they strike upon the hot end of the material. The first-operation header *I* swages or upsets the end to the form of a round collar, which represents the bushing body. The stock from which the work is forged is practically of the same size as the hole to be pierced. At the second operation in the upper die impression, the punch *K* pierces the hole through the upset collar, thus converting it into a bushing and at the same time separating the bar from the bushing. Fig. 6 shows the sequence of operations.

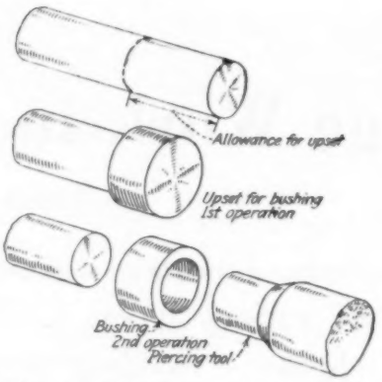

Fig. 6—Sequence of operations in forging and piercing staybolt bushings

Boiler Check Operations

Equipment for forging 2½-in. reversible boiler-checks is represented in Fig. 7. The checks in both rough- and finish-forged condition are included at the center of the illustration, but it may be desirable to refer to Fig. 8, which shows somewhat more clearly the shape of the three prongs forged equidistantly about the circular disk which forms the body of the check.

In starting operations on the forging of these parts, the bar of stock is placed under the hammer where a three-cornered form like *A*, Fig. 8 is produced. This forging operation outlines the three prongs, and disposes of a large portion of the material between the prongs, so that the subsequent operation in the finishing dies in the forging machine is simplified to a considerable degree. Then in the header die, the check is forged to appear like *B*. The shaping and sizing of the three prongs is accomplished with the tool shown near the left-hand die *L*, Fig. 7. This die is constructed with three tapered slots formed between the jaw-like projections and the slots are enclosed and the whole affair strengthened by means of a sleeve forced over the outer circumference of the tool.

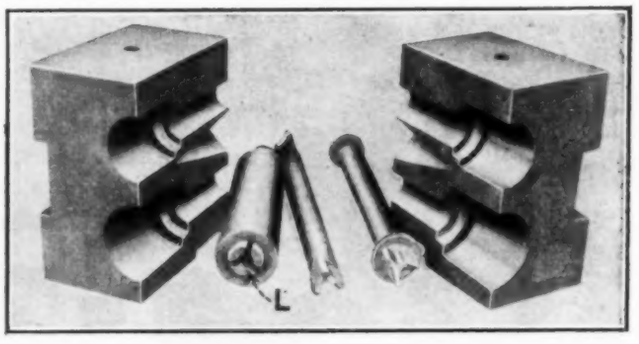

Fig. 7—Tools for forging reversible boiler-checks

The prongs taper about $\frac{1}{8}$ in. on each side and they are also formed with a slope on the underside. Thus,

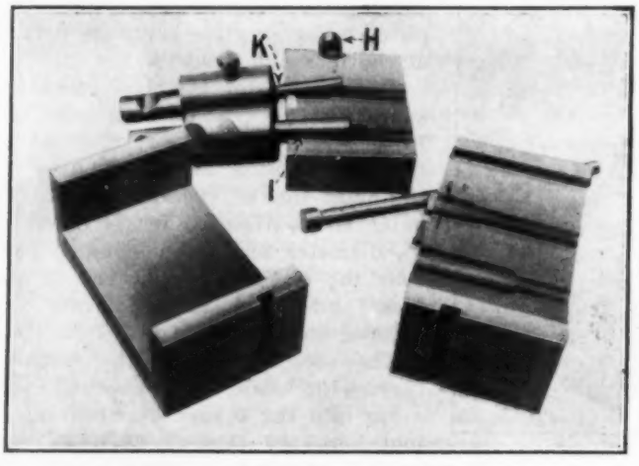

Fig. 5—Tools for making staybolt bushings

as the second-operation punch or header comes into action, the tapered slots between its jaws pass over the roughed-out prongs, and, as the stroke proceeds the prongs are formed to a neat taper with cleanly forged sides and edges. It is evident that waste of material

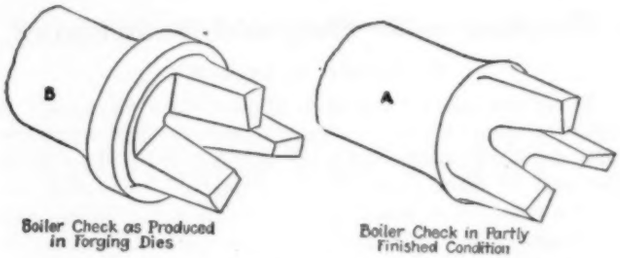

Fig. 8—Last steps in forging boiler checks

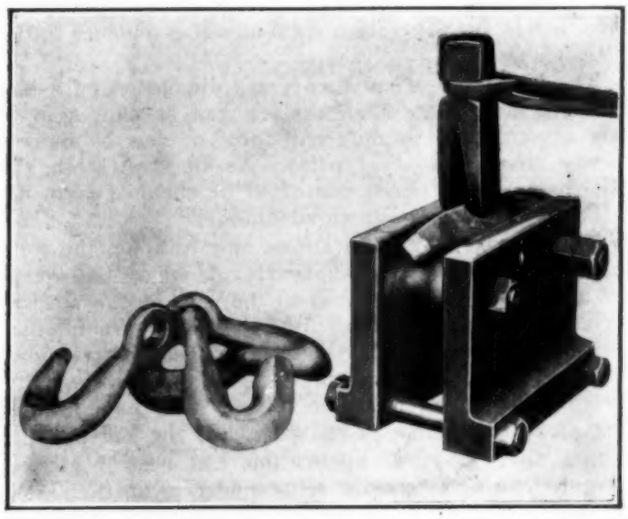

Fig. 9—Forming hooks for wrecking chains

is eliminated in this process and that machining operations required for finishing are reduced to a great extent.

The method of forming wrecking-chain hooks, shown in Fig. 9, consists in placing the square, tapered piece of hot metal under the steam hammer and forcing it down between roll-shaped formers secured between steel side-plates on the carrying fixture here illustrated. The rolls at the opposite end of the fixture are of the required diameter and groove proportions to suit the job, and the piece of heated stock when placed upon the forms rests with its corners up and down, so that when it is forced down, it is bent across its corners into the shape shown. The ends of the work are tapered in a preliminary operation, and when the blank is set on the forming tools, a steel block is held on the work by means of tongs, as illustrated, while the hammer comes down to form the work between the rolls.

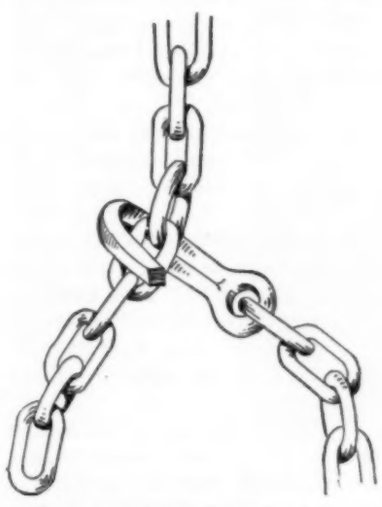

Fig. 10—How the wrecking hook is used

It will be noticed that these hooks are of somewhat different form than the conventional crane hook with its wedge-shaped cross-section and outward flaring tapered point. Instead, the wrecking-chain hook has a narrow throat but slightly tapered, and an end that is comparatively blunt. The opposite end for the chain link is flattened in another operation and pierced under the hammer. The application of the wrecking-chain hook is indicated by Fig. 10, where the point is seen slipped over a link of the chain, and thus locked between the engaging links at each side. In other words this type of hook is not intended to be slipped into a link opening, but is to be placed over the chain, with its narrow throat engaging the flat sides of the link. No time is lost in engaging or disengaging the hook. The chain is passed around the load, and the hook merely slipped over the link, and cannot become dislodged until after the load has been landed and the chain slacked.

Smooth Threads in Cast Iron —Discussion

By L. K. Goss

We were interested to note the answer in the problem, "Smooth Threads in Cast Iron," published on page 163, Vol. 63 of the *American Machinist*.

There is no question according to the practice in the Cleveland district regarding the advisability of separating the drilling and tapping operations. It is hard enough to do production tapping without injecting any unnecessary variable into the equation. The action of the drill in changing the line of stresses while the tap section is cutting is unnecessary and inadvisable. For this reason few combination drills and taps are used, in this district at least.

The statement that carbon-steel taps are best suited for pipe threads in cast iron would meet with almost universal objection from users around Cleveland. The question is whether the high-speed taps should be ground or not ground and carbon-steel taps are in the background for production work. The carbon steel will not stand up in comparison with high-speed steel and, as they begin to fail, the threads are torn and roughed. So the high-speed steel taps give a better finish on the average.

On the basis of tool cost, the carbon-steel taps are found to be much more expensive. If the high-speed steel taps are ground, the initial cost is increased slightly but there are many indications that the ultimate tool cost per piece will be reduced by grinding as in the case of straight thread taps. This last point is being carefully followed by many users of pipe taps in this district at the present time.

"Glad you fired me—it woke me up," said an ex-employee, on a visit from his new job to his old foreman. The foreman was glad things had turned out that way, but he couldn't help feeling that when he did the firing he should have been in position to point the way to a new job, instead of merely creating a black mark on the record of an employee who didn't fit his job.

Comparative Strength of Spot Welds and Rivets

IN A paper read before the American Welding Society at a meeting held in Cambridge, Mass., Oct. 21-23, Joseph W. Meadowcroft, of the Edward G. Budd Manufacturing Co., gave the results of some tests conducted to determine the comparative tensile strength between spot welded and riveted joints in sheet steel.

The results show no substantial differences in strength between welds and riveted joints in their use of them. Table I gives test results on spot welds applied to sheets of different thickness but the area of the weld itself is nearly constant. In the examples given, when the thickness of the metal is above 0.062 in., the weld itself undergoes shear. Had the area of the weld been greater it would not have failed at this point. The strain on rivets is analogous.

Table I—Tensile Tests of Spot Welds in Sheet Steel

Metal Thickness	Area of Weld, Sq. In.	Load in. Lb.	Shear Stress on Weld Per Sq. In.	
0..031	0..048	800	16,700	Sheet broke around weld
0..043	0..055	1,470	26,800	Sheet broke around weld
0..050	0..051	1,230	24,300	Sheet broke around weld
0..062	0..054	2,140	39,500	Sheet broke around weld
0..078	0..049	2,210	45,000	Broke through weld
0..088	0..0594	2,820	46,400	Broke through weld

In Table II are shown the results obtained with rivets ¼ in. in diameter headed by machines as used in the shop. The backing up tool was a diamond-knurled flat surface. Force was applied to the head of the rivets by an air hammer fitted with a die made to suit the mushroom head of the rivets. The test results are for single and double rivets. Table III shows the results with rivets of ⅛ in. in diameter, mushroom headed on both sides.

Table II—Tensile Tests of ¼-In. Rivets in Sheet Steel

Metal Thickness Single Rivets:	Load in Lb.	Shear Strees on Rivet Lb. per Sq. In.	
0..025	840	17,100	Rivet pulled out of strip
0..039	945	19,300	Rivet pulled out of strip
0..048	1,500	20,600	Rivet pulled out of strip
0..059	1,395	28,400	Rivet pulled out of strip
0..070	2,010	41,000	Rivet pulled out of strip
0..088	2,175	44,300	Rivet sheared off
Two rivets:			
0..039	1,355	13,800	Metal strip broke
0..057	2,460	25,300	Metal strip broke
0..088	4,265	47,400	Metal strip broke

Table III—Tensile Tests of ⅛-In. Rivets in Sheet Steel

Metal Thickness Single Rivets·	Load in Lb.	Shear Stress on Rivet Lb. per Sq. In.	
0..031	705	25,300	Rivet pulled out of strip
0..043	945	34,400	Rivet pulled out of strip
0..050	1,110	40,200	Rivet pulled out of strip
0..062	1,490	53,900	Rivet sheared off
0..078	1,610	58,200	Rivet sheared off
0..088	1,325	47,800	Rivet sheared off
Two Rivets:			
0..062	1,770	12,850	Metal torn and rivets pulled out at side of holes
0..088	2,945	21,300	Metal torn and rivets pulled out at side of holes

The Man in the Shop and Mathematics

BY HAROLD R. GOODRICH

There are many thousands of first-class mechanics in machine shops who are obliged to call for help whenever they are confronted with a bit of "figuring." In a small per cent of these cases, they are perfectly justified, but in the greatest number, the mechanic could do his own figuring if he would overthrow the general impression that, naturally, he does not understand enough of the science of mathematics to help himself.

The purpose of this article is not to ridicule the condition, but to try to create a state of self-confidence in the shop man.

The toolmaker often discovers a dimension on a tool drawing which, although correct, can be expressed to his advantage in a different form or can be figured better from some other point. As an illustration, the dimensioning of angles can often be changed from degrees to a linear length to advantage.

The average shop man knows how to apply the well-known rule of the right-angle triangle where the square of the longest side is equal to the sum of the squares of the two shorter sides. But, how many are familiar enough with trigonometry, or the solution of triangles, to use it in a practical way?

No doubt a large number will say they have studied "trig" at some time in the past, but the sad part remains that practical application has been neglected, largely through lack of self-confidence in their own abilities. They may compute a certain result to perfection, but they usually feel safer if it is checked by someone "higher up" in whom they are more willing to place their confidence than in themselves.

The mention of the word, trigonometry, is usually sufficient to cause many first-class toolmakers to claim lack of education in such an advanced branch of mathematics. The truth remains that as far as practical shop use goes, trigonometry need consist of only six plain definitions, which a school boy can understand, combined with a little reasoning on the definite conditions at hand.

These definitions are those for the sin, cos, tan, cotan, sec, and cosec of any angle, the values of which are given in tables easy to obtain and simple to use. A specific illustration is given as follows:

In a certain right-angle it is assumed that the length of the hypotenuse and of one of the legs is known. It is necessary to find what angle the former forms with the latter.

The sine of any angle is equal to the quotient obtained by dividing the length of the side opposite the angle desired by the length of the hypotenuse. This quotient can then be easily found in a table of natural functions and the angle read in the margin. This operation is just as simple as it sounds and applies alike to all six of the cases mentioned above.

Every man can avail himself of the almost unlimited facilities offered on every hand for easy improvement along these lines. These facilities may be in various forms, but whatever they are, no time should be lost in getting started.

Automotive Production

Getting Facts for Automobile Designers

By K. H. Condit
Editor, *American Machinist*

How the General Motors Corporation is securing comparative test data on automobile performance that are invaluable to the designing engineers

FACTS are essential to true engineering design. This statement will meet with general acceptance particularly from engineers. What will not meet with such general endorsement is that a good many designing engineers are not working from facts but are still using rule-of-thumb methods. Even the best and most conscientious designers will admit that they have not all the facts they need and are correspondingly handicapped in their application of scientific principles in their endeavor to find the solutions to the various problems that are presented to them.

Hence the vogue of the copyist type of designer. Lacking facts his only recourse is to copy successful features of competing machines. Experience has shown that certain proportions of a given part will cause it to stand up and function properly and it is therefore an act of discretion to stick to them. The fact that they were probably discovered by accident has little to do with the matter.

Two fields of machine design that have been subject to the copying disease are the automobile and machine tool industries. They are not chosen as horrible examples. As a matter of fact they are probably less subject to the disease than many other fields. They are, however, both well known to readers of the *American Machinist*. It is the purpose of what follows to show what one corporation in the automobile field is doing to provide its designing engineers with facts in the hope that other organizations in both fields will get sufficient inspiration from it to undertake something that will lead to the same result.

Pure science research probably returns, in the long run, the biggest dividend on the investment, but its processes are tediously slow and the discovery of a new principle or law of nature may take years. Applied science research is more immediate in its arrival at the desired goal but generally does not yield such large returns. It may take many months to attain its ends, however, as they may prove decidedly elusive. Physical testing is essentially an analysis of a design, a mechanism or a product that has been completed. As a consequence the facts it can demonstrate are

Fig. 1—The fifth-wheel electric speedometer used for accurate speed determination. Inertia of the wheel is so small that road inequalities do not affect readings

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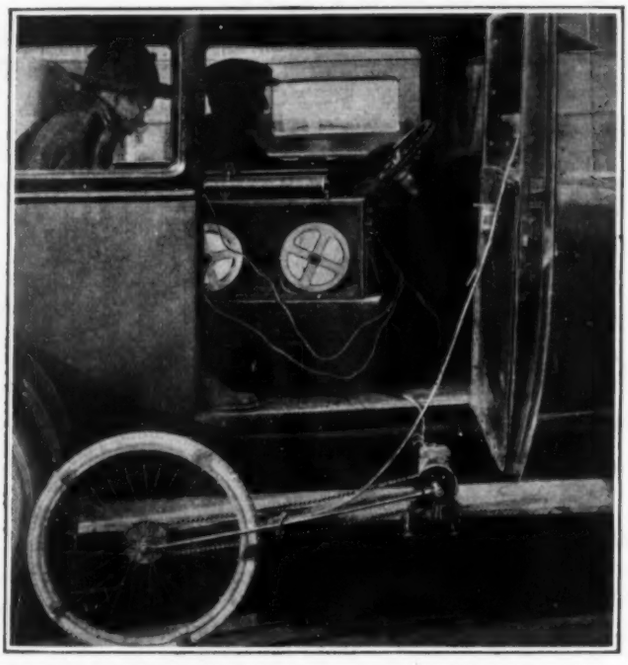

Fig. 2—The electrical apparatus used for determining acceleration. Sparks puncture time and space intervals on the moving paper roll

very quickly secured and can be used to advantage.

The General Motors Corporation is engaged in all three of the forms of investigation mentioned. Some months ago an article appeared in the *American Machinist* in which something was told of the pure and applied science research being done by the corporation. Here we are concerned only with the physical testing.

Some two years ago officials of the corporation decided that it was essential to provide better facilities for testing automobiles. It had always been the accepted practice to test out cars on the public highways but the practice was decidedly unsatisfactory from several angles.

In the first place safety considerations militated against the amount of fast running thought necessary for thorough testing. Not only was there the danger to other users of the road but there was also the liability of having an almost completed test ruined by an accident. Ideal, or even satisfactory, conditions of road surface and grade were almost impossible to find. Where they did exist traffic density made engineering tests out of the question. And last, but not least, no one knew where the tester was or what he was doing as soon as he was out of sight of the factory.

To get the test cars off the public highways and under close control it was decided to establish a privately owned preserve where ideal road conditions could be secured and maintained. The General Motors Proving Ground is the result. It is about a mile and a half square and contains the topographic features necessary for testing on hills and on the level. Something over eleven miles of concrete and gravel roads have been constructed and are in constant use. The number of miles driven in a month has risen to over 250,000, which means that 20,000 gallons of gasoline are consumed during that period. There is a dead-level concrete straightaway for speed, fuel economy, acceleration, braking and other engineering tests. There are concrete hills with grades that are absolutely uniform throughout their length. There are bad roads as well as good ones so that all sorts of testing can be done over the types of road likely to be met in service. Discipline and traffic regulations are strictly enforced.

As can be imagined one of the most important duties of the director of the proving ground is the maintenance of his roads. The gravel stretches wear rapidly under the high speed traffic to which they are subjected and the road gang is always busy.

The instruments used for measuring the various performance characteristics have been developed in the General Motors Research Laboratory and at the Proving Ground. Some are rather crude, others extremely refined, but each is well suited to the particular purpose in hand and designed for the degree of accuracy required. Stop watches, for example, are carefully calibrated and their testing and maintenance is in the hands of one mechanic who is solely responsible.

The ordinary speedometer is, of course, not accurate enough for precise measurement. Two methods are in use at the proving ground for speed determination —the measurement of time over a course of determined length and the fifth-wheel speedometer shown in Fig. 1. The latter instrument consists of a bicycle wheel belted to a small generator which is clamped to the running board. Variations in the generator voltage are read on the milli-voltmeter in the observer's lap. The voltmeter scale is graduated in miles per hour. Because

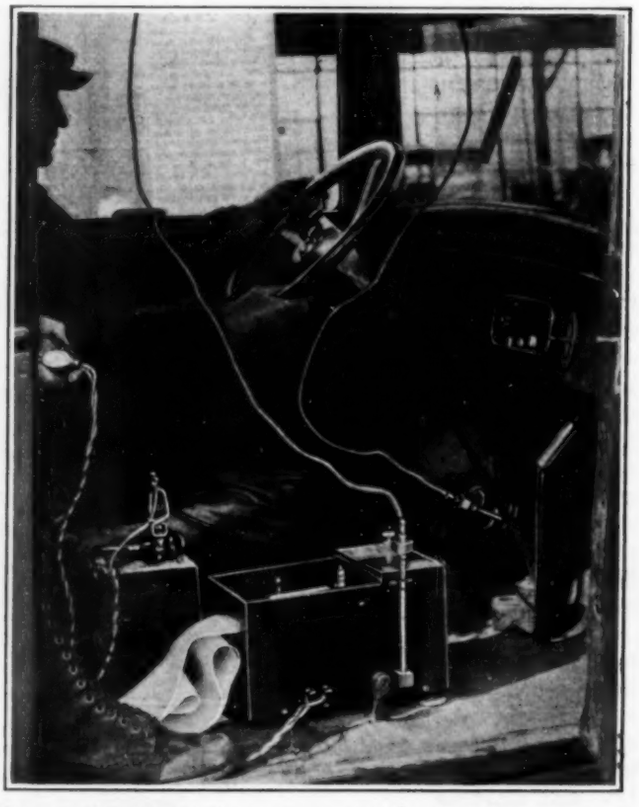

Fig. 3—Brake pedal pressures and deceleration are measured simultaneously by the apparatus illustrated

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of the low inertia of the light road wheel the effect of road inequalities is not measurable. The instrument has been found to be accurate to 0.1 per cent when checked against elapsed time over a measured course.

Acceleration determinations are made with the apparatus illustrated in Fig. 2. There the fifth wheel drives a breaker mechanism through a chain. A paper strip feeds from one of the two drums shown in the car to the other. As it passes the business end of the sparking mechanism three sets of holes are punctured in it by electric sparks. Two cams operate the breaker mechanism so that it produces punctures every foot and every ten feet of rotation of the fifth wheel. Another mechanism punctures holes at half-second intervals. The resultant space time records can be converted into a speed acceleration record by graphical integration.

The instruments shown in Fig. 3 record deceleration and brake pressure on the same paper strip. The decelerometer unit is of the James type and consists of a weight mounted on top of a stiff vertical spring. The movement of the weight is carried to an arm and pen causing the latter to move across a paper roll driven by an electric motor that receives current from a 12-volt storage battery. Pedal pressure is transmitted from a diaphragm on the brake pedal through copper tubing to a flattened tube element carrying a pen arm.

Fuel measurements are all by volume. The apparatus used is shown in Fig. 4. It consists of burettes graduated in cubic centimeters and fed through a three-way valve. Clutch pedal pressures are measured with the simple spring balance rig illustrated in Fig. 5. Steering effort is measured by means of the auxiliary wheel shown in Fig. 6. Calibrated springs move the two annular riders to maximum effort positions.

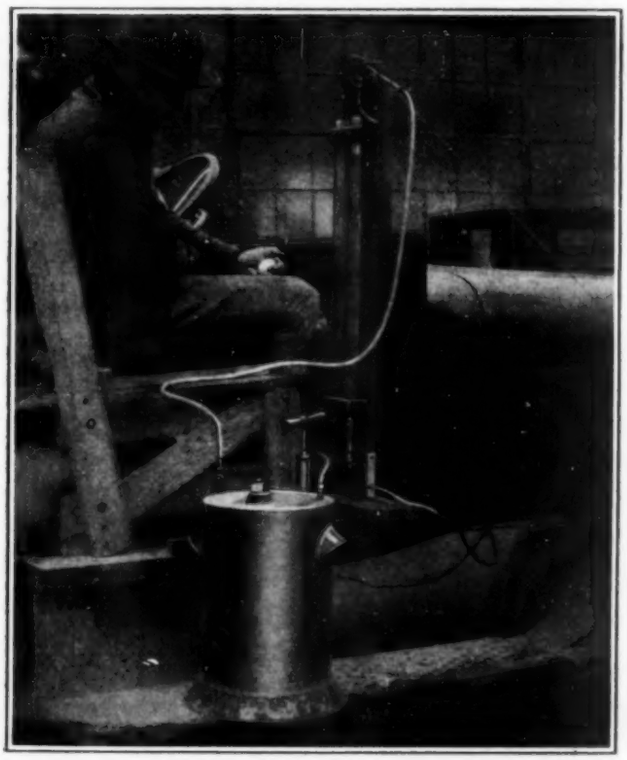

Fig. 4—The burettes and tank used for accurate fuel measurements

Fig. 5—The simple spring balance yoke employed for measuring clutch pedal pressures

Many other tests are conducted and measurements made to determine the acceptability of a car to the customer. Riding comfort, angle of vision, noise and vibration all enter into the situation when a customer decides whether or not he likes a car. In addition there is the matter of appearance. Most of us consider ourselves competent to judge this car as good looking and that one as ugly but we cannot say how we reached the decision. We do not know the proportions of radiator height to top height, of wheelbase to wheel size, of body length to overall length that make all the difference between beauty and mediocrity.

At the proving ground they are working on the beauty problem by photographing all sorts of cars under standard conditions so that negatives can be superimposed and dimensions can be recorded. For this purpose a special camera with a fixed focus and a 65-in. focal length is used. The composite car that will come from all these photographs will have proportions that can be used as guides in body and chassis design in the future.

The tests that have been mentioned are all from the customer's angle. They represent one phase of the work at the proving ground, the phase of the work that is under the direct supervision of the Technical Committee of the corporation. All cars are tested in this way. The results of each test are charted for each of the makes and models of cars tested. The chief engineer of each member company can see from the charts exactly how his product stands in comparison with other cars in the same competitive field.

It would be unfair, obviously, to compare cars on one or two factors alone. The economical car will

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probably not be as fast nor as good on hills as the one that goes fewer miles to the gallon. The one with the high axle ratio is likely to be more subject to vibration than the one with the low ratio but will probably be quicker on the getaway. But when all the charts have been consulted and the chief engineer finds that his car is trailing the field in several particulars he knows at once that something has to be done about it. The Technical Committee and the proving ground staff do not make suggestions or give orders. They secure the facts, chart them and supply them to the chief engineers who govern themselves accordingly.

The other type of testing that is going on continuously is conducted by the member companies. Each one has its own section of the garage partitioned off and can do just what it pleases in testing out its experimental cars so long as its men observe the traffic rules of the track and maintain necessary discipline.

The companies big enough and wealthy enough to conduct tests on the scale of the General Motors Proving Ground are naturally very few. There are instances, however, where tests of the same general nature are carried on by disinterested parties such as college

Fig. 6—The auxiliary steering wheel operates the main wheel through calibrated springs. Maximum pressures are recorded by the sliding collars

laboratories and reliable research institutions. Each company that submits a sample for test is given a number. When all tests have been made the samples are identified by number only. Thus each company knows where its product stands as compared with all others but does not know where any particular one of its competitors stands.

After all is said and done, facts are absolutely essential to intelligent design. General Motors designers are fortunate in having such facts before them as the proving ground tests bring out. Other designers, of other mechanical products, could make equally good use of similar facts about their own developments. Perhaps some day a means will be found to supply such facts. And the day will come sooner as engineers and executives wake up to the importance of having every possible fact to work with.

The Automobile Industry and the Machine-Tool Builder—Discussion

By L. L. Thwing

The recent debate between the automobile and machine-tool builders, published on page 525, Vol. 63, of the *American Machinist*, certainly gets to the bottom of any debatable questions between the two interested parties. There is nothing like getting grouches and kicks out in the open air so that they can be examined and adjudicated. However, a technically disinterested party might be permitted to say that there was quite a bit of the *tu quoque*, or pot-calling-the-kettle-black, element in the discussion. The reply on the part of the machine-tool men may not contain anything constructive but they would hardly have been human if they had not presented their side of the case. And the reason they could do so so pointedly, is that both industries have fundamentally the same sort of problems and difficulties. Selling goods at a profit is one of them, but in this item there is no practical comparison between the two industries. It is quite probable that the average machine-tool builder would have been better off financially if he had scrapped, liquidated and sold his assets during the dark, post-war period, and invested the proceeds in automobile stocks.

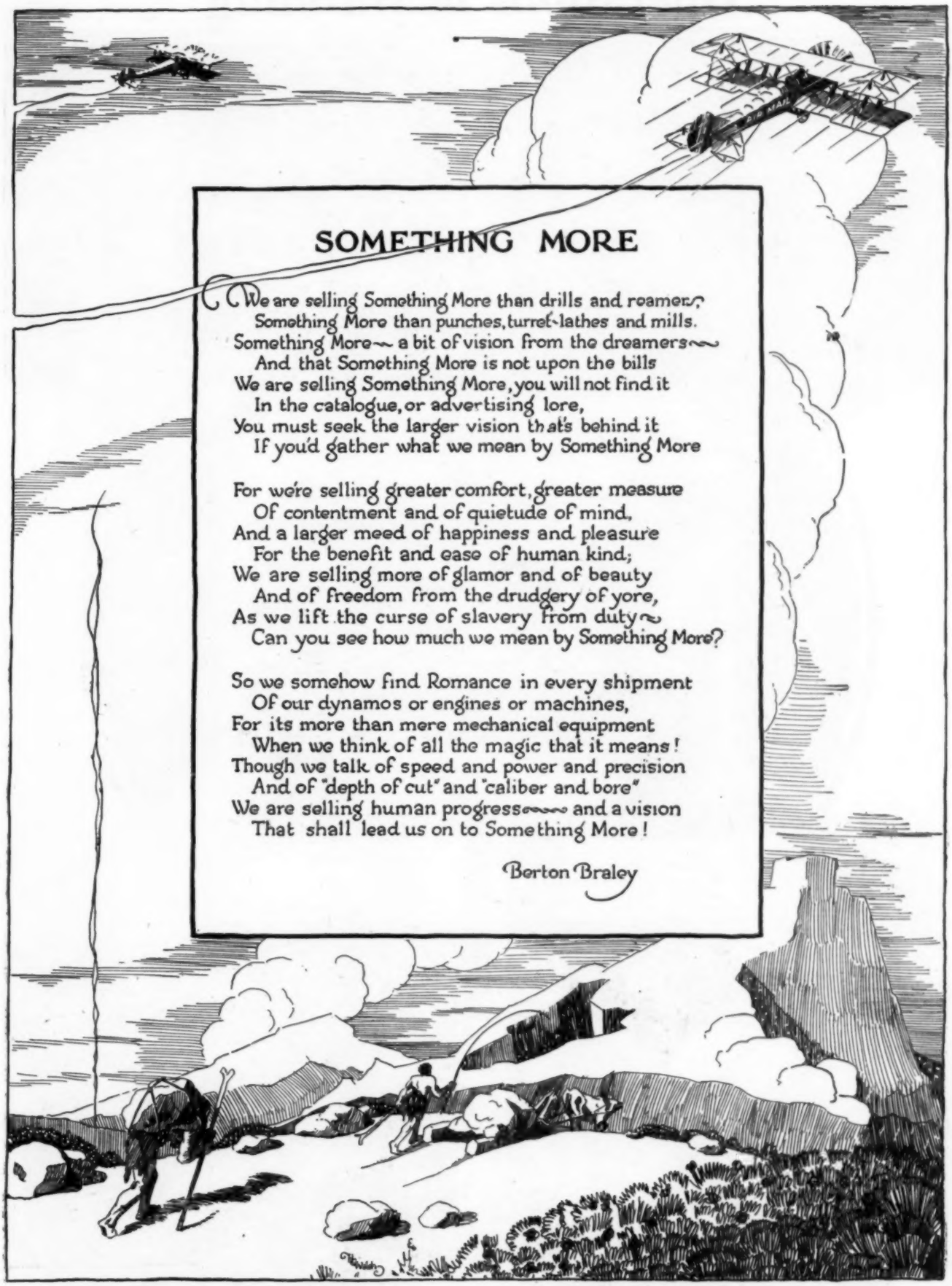
Selling to Your Equals in Knowledge Is Hard

Machine-tool builders suffer from various economic conditions that are recognized by all who read these columns. It may be a minor thing, but it is a fact that the machine-tool builder has to sell his product to a trade that, in a broad sense, knows as much about machine shops as he does.

The product of the average manufacturer is sold to a consumer who is not qualified to pass on many of the details of the product. Certainly automobile owners are not, except on the basis of repairs per mile—assuming that they take the trouble to figure it out. But when a machine-tool man tries to sell an automobile manufacturer a milling machine, he has to trade with a man who knows what good materials and good workmanship are, to say nothing of knowing just what he wants, besides. Some commodities apparently do not need to have any intrinsic worth, and can be sold by advertising alone. Machine tools, unfortunately for their builders, are not in this class.

With the sales end hammering the shop for lower production costs, instead of reducing sales cost, the machine tool builder really bears the brunt of the battle.

Where there is an unwritten law that everyone must be busy whenever the superintendent passes along, whether he has anything to do or not, something is wrong. The aim ought to center on production, not appearance. If the man is a necessary cog, and there is no work to do for the moment, it should be possible for him to keep his hands in his pockets and still look the superintendent in the eye.



SOMETHING MORE

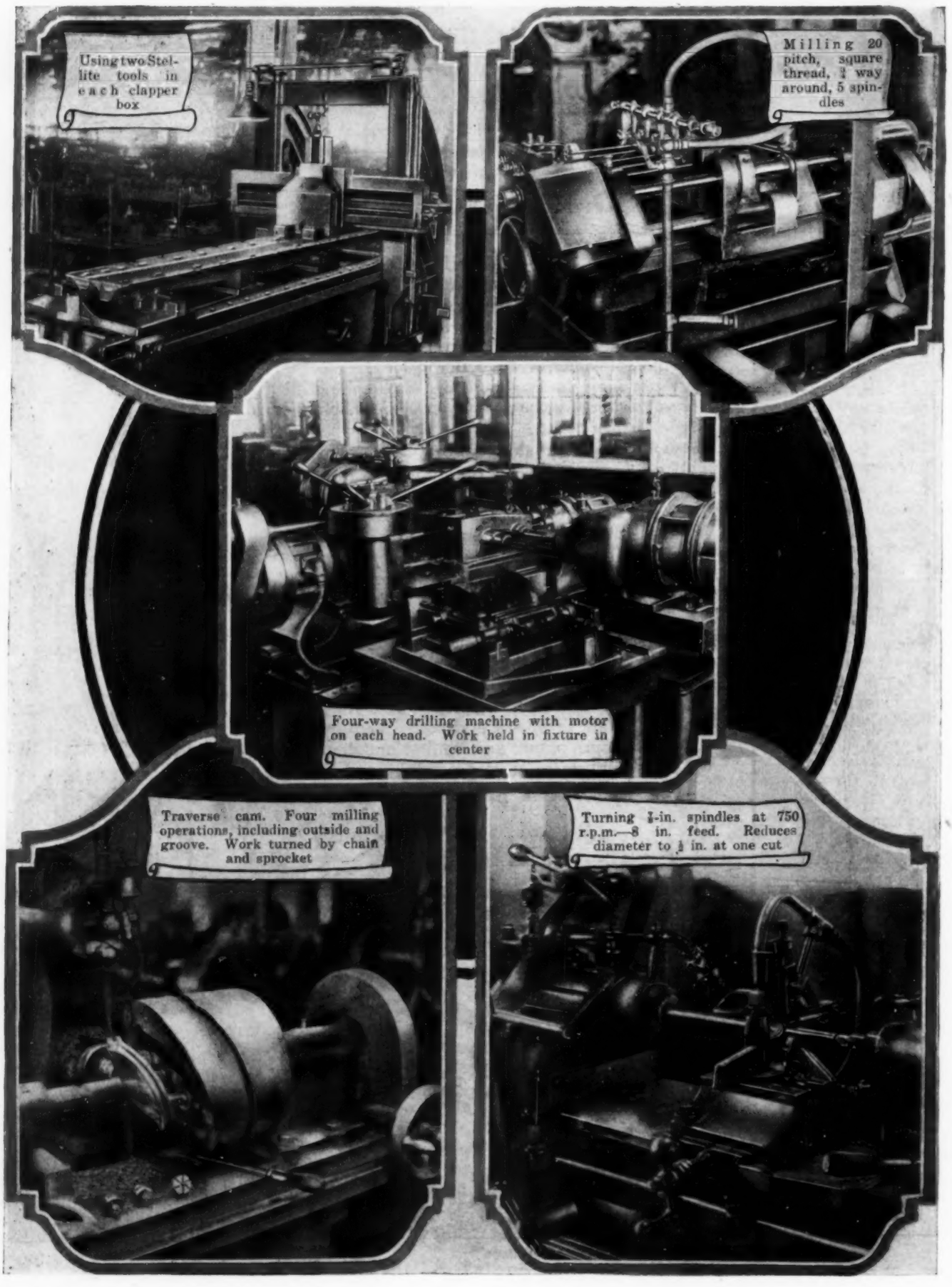
We are selling Something More than drills and reamers,
Something More than punches, turret-lathes and mills.
Something More— a bit of vision from the dreamers—
And that Something More is not upon the bills
We are selling Something More, you will not find it
In the catalogue, or advertising lore,
You must seek the larger vision that's behind it
If you'd gather what we mean by Something More

For we're selling greater comfort, greater measure
Of contentment and of quietude of mind,
And a larger meed of happiness and pleasure
For the benefit and ease of human kind;
We are selling more of glamor and of beauty
And of freedom from the drudgery of yore,
As we lift the curse of slavery from duty—
Can you see how much we mean by Something More?

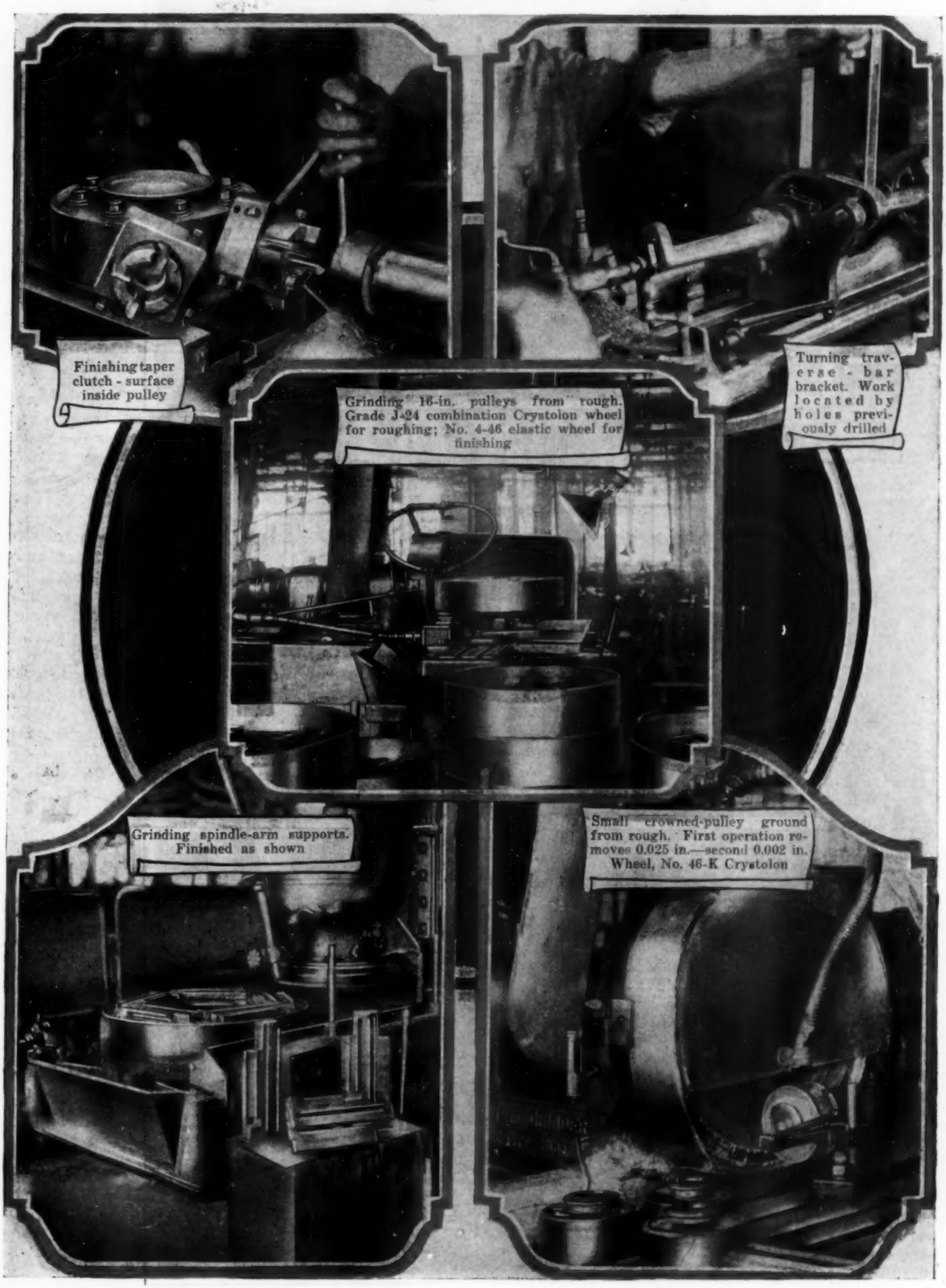
So we somehow find Romance in every shipment
Of our dynamos or engines or machines,
For its more than mere mechanical equipment
When we think of all the magic that it means!
Though we talk of speed and power and precision
And of "depth of cut" and "caliber and bore"
We are selling human progress—— and a vision
That shall lead us on to Something More!

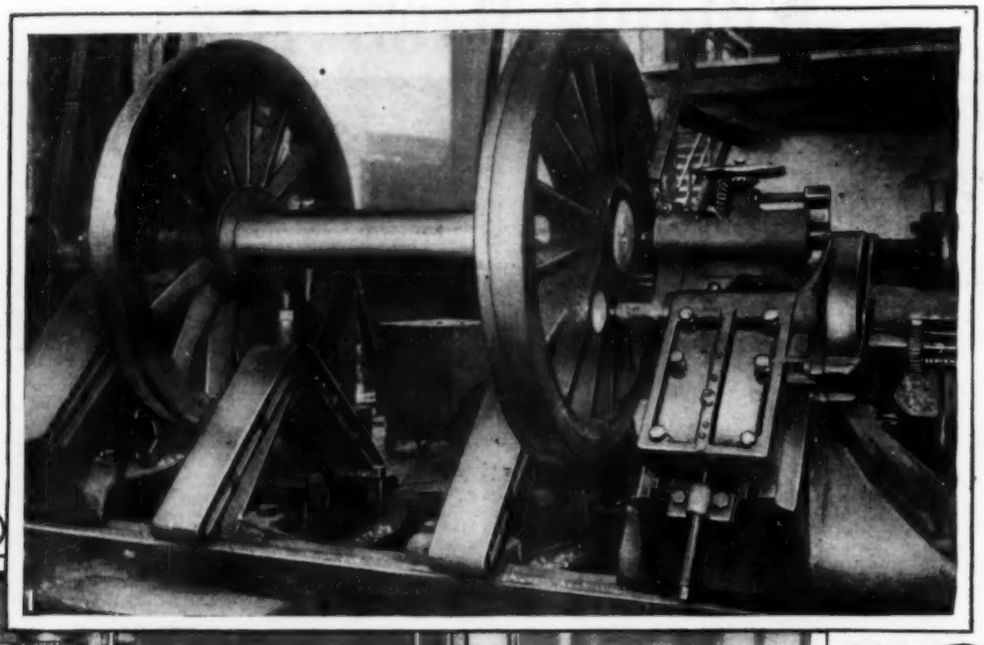
Berton Braley

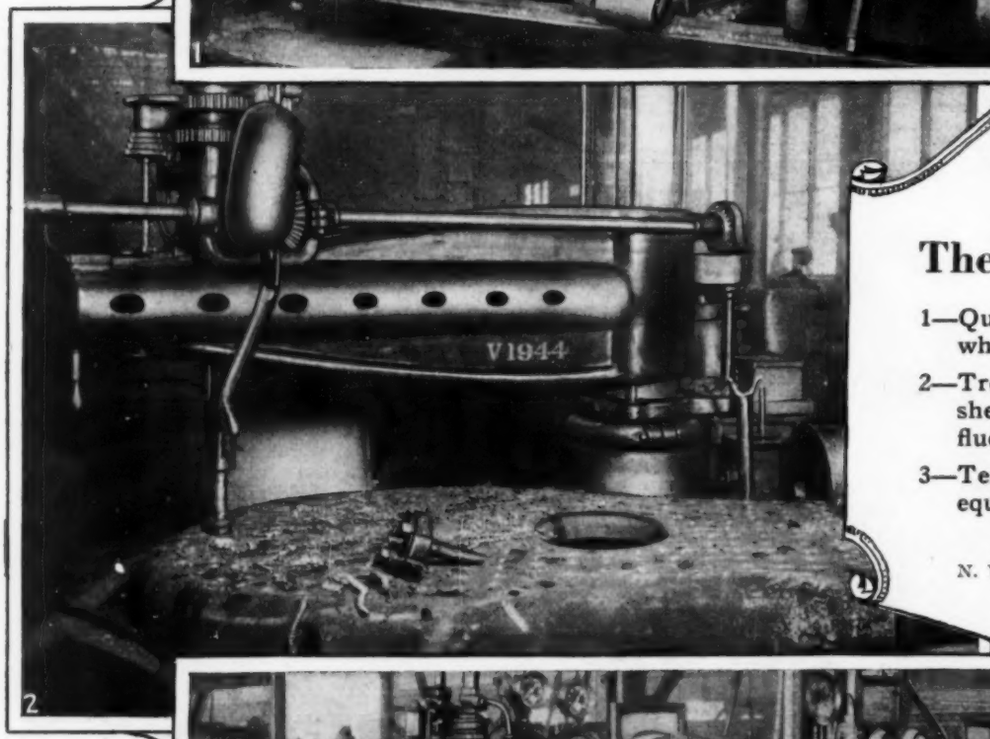
Operations in Building


Using two Stellite tools in each clapper box
Milling 20 pitch, square thread, ¾ way around, 5 spindles
Four-way drilling machine with motor on each head. Work held in fixture in center
Traverse cam. Four milling operations, including outside and groove. Work turned by chain and sprocket
Turning ½-in. spindles at 750 r.p.m.—8 in. feed. Reduces diameter to ½ in. at one cut

Winding Machinery


Finishing taper clutch - surface inside pulley
Turning traverse - bar bracket. Work located by holes previously drilled
Grinding 16-in. pulleys from rough. Grade J-24 combination Crystolon wheel for roughing; No. 4-46 elastic wheel for finishing
Grinding spindle-arm supports. Finished as shown
Small crowned-pulley ground from rough. First operation removes 0.025 in.—second 0.002 in. Wheel, No. 46-K Crystolon





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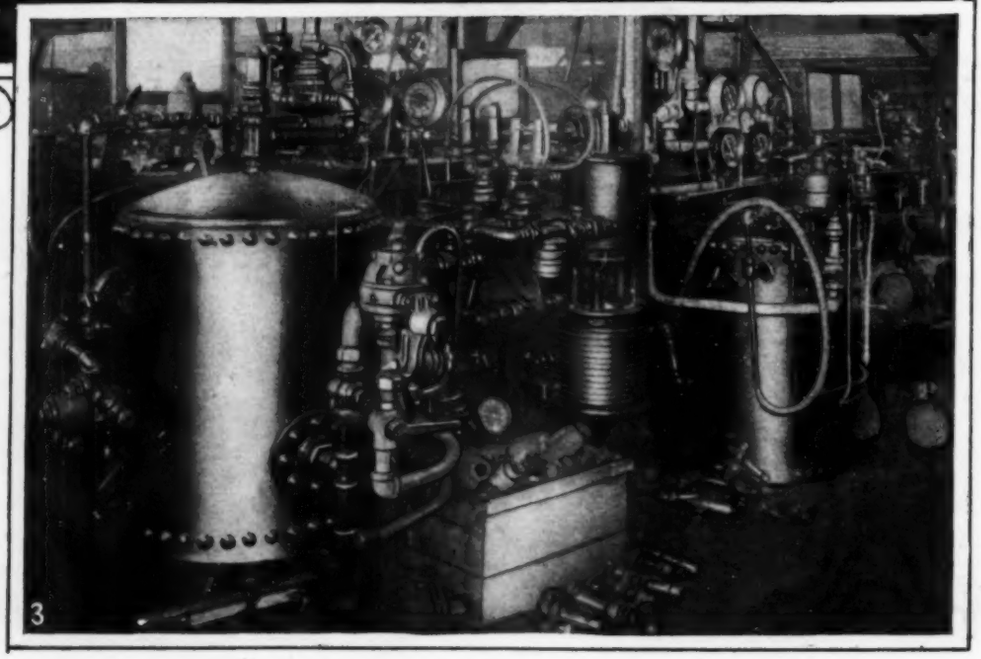

3

In The Back Shop

1—Quartering driving wheels

2—Trepanning a back sheet for superheater flues

3—Testing air-brake equipment

Courtesy of the N. Y., N. H. & H. R. R.

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Materials Used in Electrical Machine Design

By Joseph Kaye Wood
Consulting Engineer, New York City

Electrical properties of various metals and the uses to which they are put—A corresponding discussion on the varieties and characteristics of materials for insulation

VARIETIES of materials are used in the manufacture of electrical equipment due to the enormous growth of this industry in the past 25 years. Today many of the large concerns have a special department devoted entirely to the study and quality control of the numerous materials that continually flow into the regular channels of production. New materials are constantly being developed in the laboratories of these departments and it very often happens that considerable reduction in costs and better performance are thereby effected. Smaller concerns do not have the advantage of being so well equipped to improve the quality of their materials, because of the lack of capital and proper personnel. Nevertheless small firms have obtained remarkable results by giving careful study to the material requirements of their product.

The machine shop naturally falls in for the fabrication of a large number of the materials used in the electrical industry. The principal materials are the metals, but there are also quite a few insulating materials to be considered, such as rubber, phenol plastic, wood, porcelain, slate and many others. The present article touches upon only a few of the most important of these materials.

The Three Chief Requirements

As usual, economical investment, space and weight limitations are the three chief requirements to be considered after proper performance has been assured. Proper performance brings in all questions of design from the standpoints of mechanics, stress and service wear due to abrasion, corrosion, fatigue and so forth.

One of the most important services to which metals are put in the electrical trade is that of providing materials to make and break or vary contact in a metallic circuit, to control the flow of current. Some mode of mechanical motion is imparted to the contact elements, to make them function accordingly. By virtue of the electro-magnetic phenomena accompanying this manipulation of current flow, the mechanical enegy originally put into the system is reproduced for useful purposes.

The selection of material for the contact elements depends upon two principal considerations, namely, the electrical characteristics of the circuit controlled by the contact and the energy employed for operating the contact elements.

In the first case the currents employed may be so small as to prohibit any considerable change in contact resistance or the inductive effect may be so great as to produce arcing. For such conditions the precious metals have to be used in place of the base metals, provided of course the pressure of contact is relatively small.

The important properties which should be considered in connection with contact metals are specific resistance (electrically), melting point, specific gravity, resistance to wear, machinability, resistance to corrosion and to arcing.

The highest conductivity is always found in a pure metal, the inclusion of any alloying substance reducing this quality considerably, particularly if the added substance forms a solid solution with the pure metal. It has further been found that if a metal of superior conductivity be added to another metal the conductivity of the resulting alloy is less than that of the latter metal.

Uses for the Precious Metals

The principal advantages of the precious metals are their resistance to corrosion and erosion. They are very costly, which naturally limits them to cases of strict necessity. Precious metals for contact are employed by the manufacturers of radio, telegraph and telephone equipment in which the current and control pressures are relatively small. Since, however, only the immediate surfaces are made from these metals the cost is not so great as might appear at first glance. Probably between one and two million dollars worth of precious metals are being consumed annually in the United States by these manufacturers.

Platinum, due to its superior qualities for resistance to erosion and corrosion is the best metal for contact purposes, although it ranks highest in cost. Palladium, which is nearly as good as platinum, costs about the same per pound, but since it weighs only half as much, the utimate cost of palladium contacts is about one-half that of platinum. The specific resistance of platinum is about 8.98 mircrohms per cu.cm. and for palladium it is about 10.0 microhms per cu.cm. The melting point of platinum is 1,776 deg. C. and of palladium it is 1,560 deg. C., while the specific gravity of the former is about 21.0 against 12.0 for the latter.

Tungsten on the other hand has a melting point of 3,200 deg. C. and is very hard which makes it suitable for high contact pressures, large currents and severe inductive effects. From the standpoint of the machinability it is objectionable because of its extreme hard-

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ness. While it is cheaper than palladium or platinum, it is inferior because it tends to oxidize more readily thus increasing the contact resistance from an electrical standpoint. The specific resistance of tungsten is 5.5 microhms per cu.cm. and the specific gravity is 19.0. High conductivity and resistance to corrosion therefore are not obtained with tungsten.

In vacuum-tube sockets a contact metal having very high conductivity and at the same time marked resistance to corrosion is required. For this purpose an alloy consisting of about 70 per cent of gold, 25 per cent of silver and 5 per cent of nickel, which is listed by Wm. Campbell of Committee B-2 of the A.S.T.M. as a platinum substitute for electrical purposes, is a good contact metal.

The relative softness of this alloy is not a serious objection because the "make" and "break" operations of the vacuum tube and its corresponding socket are relatively infrequent. The specific resistance of such an alloy, depending upon its composition, is approximately equal to that of palladium. The specific gravity is naturally much higher and the melting point much lower for this alloy than for palladium.

For resistance to wear and heavy arcing the thermocouple alloy consisting of about 90 per cent of platinum and 10 to 15 per cent of iridium is often used. This alloy which is also listed by Campbell gives a specific resistance of about 26.0 microhms per cu.cm., a melting point of 1,800 deg. C. and a specific gravity nearly the same as for pure platinum.

By alloying about 70 per cent of gold and 25 per cent of silver with 5 per cent of platinum (page 27, Campbell's "List of Alloys"), a contact metal can be had that costs much less than pure platinum. This can satisfactorily withstand fairly heavy telephone currents and the inductive "kicks" usually met with in telephone and telegraph practice due to the close proximity of these lines with power lines.

The Field for Base Metals

The usual base-metal contacts are made from phosphor bronze, nickel-silver, copper and brass. Most of these metals are free from severe corrosion difficulties, although their surfaces must necessarily be cleaned periodically or be made self-wiping. Phosphor-bronze and nickel-silver are commonly used when the elements are also springs providing their own pressure of contact.

Pressures should always be maintained below a maximum limit in order to guard against wear and above a minimum limit in order to obviate high electrical contact resistance. Extreme care is needed in adjusting contact springs, particularly when the minimum and maximum limits for pressure constitute a narrow range. In giving these springs the requisite set care should also be taken not to overstrain them too severely by an unreasonable amount of bending.

In the foregoing discussion on contact metals the term erosion was taken to mean wear due to both friction and electrical arcing. Corrosion, which would take place under ordinary atmospheric conditions, is greatly enhanced under elevated temperatures due to the formation of special oxides.

Steel castings, forgings, rolled sections, rolled sheets, drawn bars or wires, any of which may or may not be heat-treated, are employed to a large extent in both the communication and power fields of the electrical art. Stator-frame castings and rotor forgings are made of ordinary carbon steel. Silicon steel is used for pole laminations.

According to the General Electric Co.'s practice the laminated poles of a d.c. machine are held together by either wrought-iron or steel rivets and have shims where they are secured to the frames in order to vary the air-gap resistance. The armature is keyed on a cast-steel or cast-iron spider. Small steel I-beams are spot welded to the laminations at intervals to give air space for cooling purposes. Laminations used on armatures are japanned or enameled to insulate them. Wood or composition wedges and binding wire hold the coils in their respective slots against centrifugal force.

Many other metals, such as copper for bus bars, brushes and commutators, brass for magnetic insulation purposes, lead and antimony for cables, copper for conductors and zinc for storage batteries are used in the electrical trade.

Materials with certain magnetic properties are required for both communication and power purposes, in the former case the designer being closely limited. For communication purposes the magnetic materials may be divided into two classes, electro-magnetic and permanent-magnetic materials.

In the former class we have magnetic iron, silicon steel, electrolytic powdered iron, and silicon cast iron. In the latter there are chrome steel, carbon-manganese steel, tungsten steel and cobalt steel.

Silicon steel is much harder than magnetic iron, has a lower coercive force, and has a higher permeability when annealed, except above certain flux densities when the permeability becomes lower. The specific resistance of silicon steel is also much higher than that of magnetic iron.

Iron and Steel for Magnetic Purposes

When soft iron or steel are to be used in a magnetic circuit they are annealed after being worked in order to relieve the condition of strain which, according to L. Fraichet, affects the magnetic properties of the metal, to reduce the permeability. The cores of loading coils in telephone transmission lines were formerly made of low-carbon steel wire, hard drawn, but at the present time electrolytic powdered iron is being used. At low densities the hystersis and eddy current losses in this material are practically nil while at higher densities they are more constant than in the low carbon steel wire. Up to a few years ago tungsten steel was considered the best material for permanent magnets so far as space limitations and high magnetic flux densities are concerned, but quite recently cobalt steel has been found to surpass it.

Separate consideration should be given to the selection of an insulating material, depending upon whether it is intended for communication or power equipment. In the former type of apparatus, if small current leakages are encountered due to surface conditions, then transmission losses are high. Only a slight variation in surface resistance due to dust, humidity and other atmospheric conditions are needed to cause intolerable current leakages. It follows that the material which has the smoothest surface and a surface that is non-absorbent will tend to be the best insulator for communication purposes. In other words moisture, dust and the porosity of the material at the surface, all other things being equal, will lower the insulation resistance at the surface and promote current leakage. The volume insulation resistance is not so important in

communication work because of the low voltages generally employed, except in some phases of radio design.

The factors to be considered in selecting an insulating material for the three general classes of electrical equipment are as follows:

1—Power equipment—Dielectric strength and mechanical strength should be high. The material should have all other properties necessary for the design of power machinery such as resistance to impact, vibration and corrosion. Its strength should be maintainable at elevated temperatures and the machining qualities should be satisfactory for economical production.

2—Radio equipment—Materials should be employed that have strength and resist chemical decomposition under heating caused by high frequency currents. Insulation resistance must be kept high by maintaining the proper surface conditions.

3—Telephone equipment—The insulation resistance of the material should be high. The surface should be free from porosity. The material should be non-corrosive, should have good mechanical properties and be not subject to leakage of current under 120 deg. F. and relatively slight pressures.

From the purely electrical standpoint hard sheet rubber, when new, is about the best insulator known. Unfortunately, however, it is subject to deterioration and a corresponding loss in its original electrical characteristics, including dielectric strength and resistance to volume and surface leakage. It is subject to leakage under small loads and at low temperatures.

The early deterioration and drop in surface resistance is caused by unfavorable atmospheric conditions and sunlight. In the case of molded rubber, metal parts cannot be inserted without corroding, due principally to the sulphur content in the rubber compound.

The dielectric strength of new rubber, as given in "Electrical Insulation" by Wm. Stanley Feight is about 1,500 volts per mil. It is machinable, but severe on cutting tools due to its hardness and brittleness. Its tensile strength, according to Feight, is about 1,700 lb. per square inch and compressive strength about 3,700 lb. per square inch.

Phenol Plastics for Insulation

On account of the many disadvantages of rubber for insulation the electrical trade is turning to the more expensive material, phenol-formaldehyde, both molded and laminated. The trade names of the molded variety, whether before or after curing with a binder, are Bakelite, Condensite and Redmanol, while those of the laminated class are Micarta, Bakelite-Micarta, Bakelite-Dilecto and Formica.

The advantages of these material, when properly made, are that they are not subject to cold leakage or deterioration and will not absorb any great amount of moisture. They are a little more difficult to machine than rubber, but with tools having sharp cutting angles good results can be obtained.

They are stronger than hard rubber, the tensile strength for the molded form being about 5,000 lb. per square inch and for the laminated form about 18,000 lb. per square inch. The corresponding compressive strength is 30,000 lb. per square inch for both forms. Dielectric strength for the molded type, as given by Feight, is about 500 volts per mil. and for the laminated type varies from 300 to 1,000 volts per mil. Phenol plastic of the molded type does not corrode metallic inserts and is used very largely in this work

Phenol-formaldehyde products consist of two parts, the binder and the filler. The binder is the condensate resulting from the chemical reaction between phenol (carbolic acid) and formaldehyde. If fully completed, this reaction yields an almost infusible and insoluble resin. But in practice the reaction is not completed before adding the filler, in order that the binder may be left in the more favorable form, fusible and soluble to thoroughly impregnate the filler. In this form it is sold to be worked further for specific purposes.

The soluble binder, which has the appearance of varnish, is then thoroughly mixed with the filler so as to produce a uniformly impregnated product. This product is then subjected to a pressure of about 1,000 lb. per square inch in a hydraulic press at a temperature of about 370 deg. F. for approximately one hour.

The process brings the half-cured binder into a plastic state whereupon the chemical reaction which was previously checked before adding the filler, is completed.

Thus a material is produced that is infusible and insoluble, strong due to the filler, resistive to corrosion and acids because of its inertness, and good in the surface characteristics, particularly when it is polished. The quality of the products may be varied greatly by changing the type of filler, the degree of curing and the care in manipulation.

It is little wonder that this material, although costly, is being used so widely as an insulating material in the electrical trade.

Mica for Use as a Heat Resistor

Mica, when used alone, has good insulating characteristics, except that surface leakage takes place under high humidities. Its chief advantages lies in its heat-resisting property. Mica, combined with shellac under heavy pressure, forms micanite, an insulator slightly inferior to mica due to its shellac binder.

Other types of hot-molded insulating materials have binders consisting of shellac, dammar rosin, pitches, asphalts and fillers of wood pulp, cotton, linen, magnesia, mica, silicon and asbestos.

In general, molded insulating materials employing shellac as a binder are inferior to molded phenol plastic because of early deterioration, which sets in to result in a drop in the original electrical characteristics and also because of their lower strength and greater difficulty in machining. They will soften and leak electrically at 140 deg. F., or lower. They are cheaper, however, and can be molded more conveniently with little waste.

In the ceramic class of materials there are many insulators whose dielectric strength usually runs about 1,000 volts per mil. For the molded mixtures, clay, quartz, feldspar, gypsum, chalk, slate, sodium and silicate are used. Porcelain is one of these, containing about 22 parts by weight of feldspar, 50 parts of clay and 28 parts of silica. Electrically, porcelain is a good insulating material due to its fine surface glaze which is non-hydroscopic. It has low impact resistance, although its tensile strength is 9,000 lb. per square inch. Its compressive strength is 50,000 lb. per square inch. Porcelain cannot be machined, however, after it is baked, but must be ground to size.

Slate is a poor insulator alone as compared with rubber or phenol fiber because it is hydroscopic and of a flaky construction. On the other hand, some good grades of slate in the dry state may run very high in

electrical resistance. Good slate can also be drilled, sawed and fabricated for power and radio panels.

Paper is used in large quantities for condenser and cable insulation. Cable paper must be strong for purposes of manufacture, cable-making machines being necessarily required to go at high speed. Condenser paper is made from linen rags.

Vulcanized fiber is used on a somewhat large scale, but has a tendency to promote corrosion due to to its zinc chloride content. It is hard on cutting tools, being quite brittle when dry. It also absorbs water which causes swelling, warping and partial loss of good mechanical and electrical properties. It is a fairly good insulator when dry and when it is not too dry it has good mechanical strength.

The Repair-Parts List

BY A. M. MORRIS

A short time ago I had occasion to order a repair part for a standard production tool, made by a well established firm. Not having a repair-parts list, I simply named the part and sent in the order. The item called for was one set of roller bearings.

After a wait of two weeks there arrived, what was purported to be, the fulfillment of the order—one complete set of huge cast-iron rollers—the same kind, in fact, for which I had ordered the bearings. After due exchange of letters, the rollers were returned to the sender, and another two-week period elapsed.

Then, to my great surprise and greater disgust, the receiving department sent over to the manufacturing floor, marked with the original order number of my set of bearings—a set of eight castings, totaling over 200 pounds in weight—very obviously the bearing housings for the ends of the shaft for which I wanted the bearings.

In desperation I made a sketch of one of the roller bearings, and dispatched this to the manufacturer. This time I received the bearings.

If all his sales are as profitable to him as this simple replacement must have been, the federal income tax need certainly hold no terrors for him.

The point of all this, the absolute truth by the way, is that repair-parts lists, furnished with machines when they are sold, mean dollars to the machine manufacturer, both in the sale of replacements themselves and in the paving of the way for future sales. A machine that is out of commission more than a reasonable length of time, whether on account of breakdowns, worn-out parts, or inability to get new parts in a hurry, certainly does not recommend itself to the man who is "stuck" with it; and when the time comes for him to renew his equipment, or to add to it, he generally knows what he does *not* want, at least.

The circumstance cited would have been impossible, had the maker of the machine kept in touch with his customer to the extent of keeping an up-to-date parts list in his hands. To be sure, the writer might have sent the sketch with the order in the first place and thus have avoided the misunderstanding. But, does not the burden rest with the maker rather than with the user? And all repair parts are not so simple to sketch as a little roller bearing.

Certainly, the maker is in better position to designate the parts of his own machine. He knows that certain parts must, through wear, tear, and accident be replaced by him, from time to time, so why does not a repair-parts list recommend itself to him? Judging by the practice of some makers, their products must be indestructible.

Many machine builders furnish a small pamphlet, giving the illustration, name, and number for every part composing their machines. What a joy is such a catalog to the maintenance man!

Others put into the hands of their customers a complete set of blueprints covering the machine so that one may order by drawing and figure number. This is safe and easy.

Others show an assembly of the machine, or of its component units, marking distinctly, with arrows, the names and numbers of all parts. And still others send, or include in the crating of the machine, a typed list of the individual parts, referring to pattern numbers wherever possible, at least, giving a name to each part which may be used as a common term when ordering that part as a replacement.

All these methods are good, their degree of excellence being in the order given.

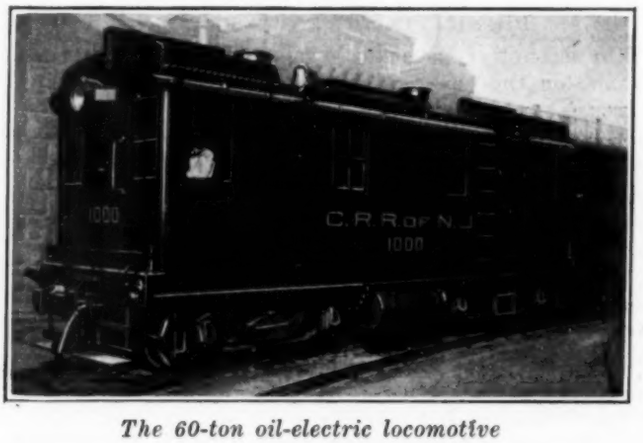
Surely no builder of machines can afford to overlook his obligation in this matter of repair-parts lists.

Two New Oil-Electric Locomotives in Operation

The purchase of a 60-ton oil-electric locomotive by the Central Railroad of New Jersey has been announced. The accompanying illustration is a view taken at its Bronx Terminal when the locomotive was placed in service. The Long Island Railroad has acquired a 100-ton model.

The American Locomotive Works co-operated with the General Electric Co. and the Ingersoll-Rand Co. in the production of the Central Railroad locomotive which has an oil engine of six cylinders of the four-cycle, single-acting, vertical type. The engine is started by air at 200 lb. pressure.

The generator is direct-connected to the engine and has a range of from 200 to 750 volts according to the



The 60-ton oil-electric locomotive

engine speed. The locomotive has a double control, a throttle regulating the engine speed and a master controller or switch to put the motors in series or in parallel as desired.

The 60-ton locomotive can develop 300 hp., a tractive effort of 36,000 lb. and maintain a speed of 30 m.p.h. The 100-ton model can operate at the same speed and develop a tractive effort of 60,000 lb. with 600 horsepower.

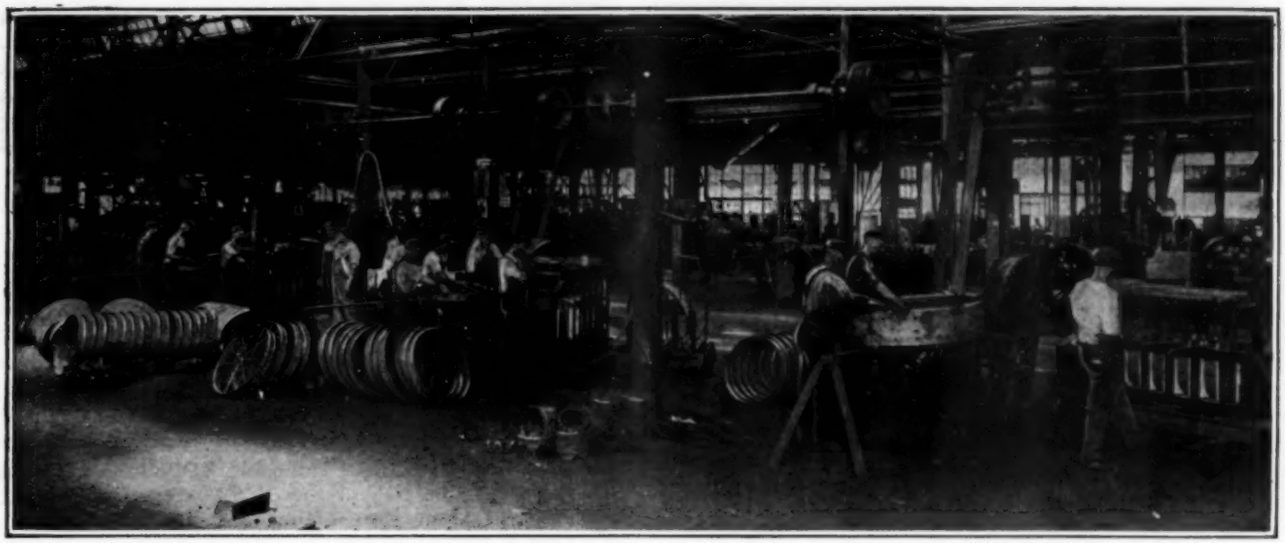


Fig. 1—An electric spoke heater installation in the wheel-assembly plant of the Electric Wheel Co.

The Electric Metal Heater in Wheel Manufacture

By W. E. Irish
Associate Editor, *American Machinist*

THE accompanying photographs were taken in the plant of the Electric Wheel Co. at Quincy, Ill., and illustrate that company's spoke assembling department where electricity has been resorted to for heating the spokes prior to assembling them in the wheel rims and securing them by means of heading machines.

In Fig. 1 is shown a general view of one side of the department. Three assembly units are shown, each consisting of the header and an electric heater, the latter being of the five-point variety or capable of heating five spokes at one time. The clarity of the air due to the complete absence of smoke from the heaters is a feature in this illustration.

A more detailed view of one of the units is shown in Fig. 2 where the close arrangement of header and heater is at once noticeable. This, of course, is possible, due to the fact that the electric machines radiate very little heat and can be set as close to the workmen as may be convenient for the work in hand, without danger of burning anyone.

The spokes, cut to length, are stacked on a tray above the heater and are taken from there to replace those that are fed hot to the heading machine. The operation consists in depressing a treadle to open one of the sets of heater jaws and release a heated spoke, to place this spoke in the rim for heading, to take one of the cold spokes from the tray and close the jaws upon it by releasing the foot treadle. The heater is adjustable as to position of the heated portion, the length of the part heated and the time element for the heating to take place. Five points at work on average size spokes are more than fast enough to keep the gang at top speed.

In Fig. 3 is shown a front view of one of the heaters mounted on a portable truck so it can be transported about the shop and placed to the best advantage. The company has installed plug-in outlets at convenient points about the shop so time is not lost in getting ready to work.

The company kept a daily record of the spokes heated and headed on one of the units for a period beginning on June 2, 1925, and ending on August 12, in order to

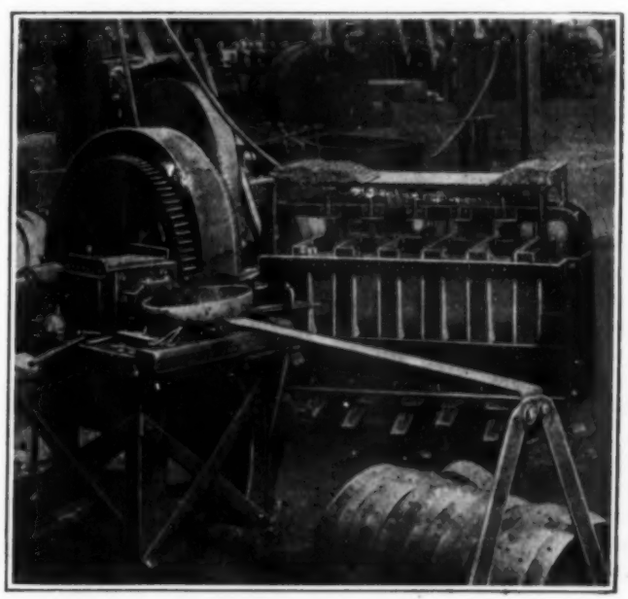


Fig. 2—A closeup view of one of the units

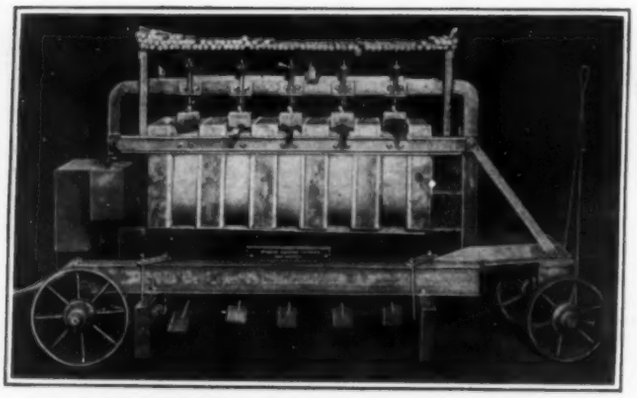


Fig. 3—The "Berwick" electric bar heater

check the performance of the electric heaters. The following is a summary of this record for the one heater with the header and gang:

Days worked	60
Hours represented	500
Total spokes handled	281,490
Average spokes per hour	562.9

The spokes that were handled ranged, in diameter, beween ½ and ⅞ in. and were heated on 3 in. of their length.

Development in Industrial Standardization During 1925

By C. E. Skinner
Chairman, American Engineering Standards Committee

THE closing year has shown important developments in the growth of the industrial standardization movement. One of the most important of these has been the increase of active interest on the part of industrial executives. A conference of first-line executives, held early in the year, organized a committee from its number to serve as an advisory committee to the American Engineering Standards Committee, and these men are now giving time and assistance to the solving of national standardization problems. Formerly, the matter of standardization was left largely to the technical man, but it is now generally recognized that standardization is a managerial problem of the first rank.

Of special interest to the factory owner and manager is the Directory of Specifications, published in August, 1925, by the Department of Commerce. This compilation lists approximately 27,000 existing specifications covering 6,000 commodities, and it will be found very useful in connection with purchases. The astonishing multiplicity of specifications on the same subject has brought sharply forward the problem of unifying them into consistent groups. Such unification is an industrial and economic problem of the first importance.

In so brief a review the standardization activities of the hundreds of organizations, trade, technical and governmental, cannot be listed. However, the work of the American Engineering Standards Committee is typical of the standardization movement as a whole, since the committee acts as a general clearing house, and each project promulgated under its auspices represents the combined effort of many such organizations.

The list of projects now before the A.E.S.C., at various stages of development, totals 218, including 76 approved standards. Notable progress has been made during 1925 in the completion or further development of many of these projects. The number of projects of each industry represented in this work, through 250 national organizations, is as follows: Civil engineering and the building trades, 35; mechanical engineering, 63; electrical engineering, 32; automotive (automobile and aircraft), 4; transportation, 9; shipbuilding, 1; ferrous metallurgy, 9; non-ferrous metallurgy, 15; chemical industry, 12; textile industry, 3; mining, 16; wood industry, 5; pulp and paper industry, 1; miscellaneous, 13.

In the field of mechanical engineering, a system of limit gaging, together with a comparative scheme of fits, which is probably the most important project ever carried through by the American Engineering Standards Committee, lays the basis for the carrying out of complete interchangeable manufacture on a national scale, as well as for facilitating mass production within the individual factory. When this work permeates the structure of American manufacturing industry, the resulting savings will run into enormous figures. Two important dimensional standards, dealing with cold-finished shafting, and square and flat shafting keys, have also been approved.

At a conference in December a comprehensive program for the standardization of drafting room practice was launched. There has been great interest in this subject and it bids fair to become a matter of first importance on account of the wide range of industries which it affects. Although many individual factories have already worked on the standardization of drafting room practice, we are on the whole far behind European countries in bringing about the economies which are possible through national standards.

For the first time complete national agreement has been reached on a safety code for aeronautics, in the development of which the military and civil branches of the Federal government and the commercial and public agencies interested in the subject were represented. The code deals with standards of safety for design, construction, testing and operation of aircraft.

In the field of industrial safety, satisfactory progress has been made on a program of some 40 codes, most of which are applicable to factories. Seventeen of these have been completed, and work on half of the remainder is well advanced.

The fourth year of the work of Mr. Hoover's Division of Simplified Practice has shown even more rapid development than heretofore. In all, 39 simplifications have already been carried through, 10 others are in the final stages, and 65 additional surveys are now under way. Over two hundred industrial groups are co-operating in the various projects.

Approximately 350 specifications have been promulgated by the Federal Specifications Board, which means that these specifications have been unified as between the various branches of the government. A leading part in this work is being taken by the Bureau of Standards, the director of the bureau being ex-officio chairman of the board.

Standardization on an international scale is still in its infancy; yet through the co-operation of the various national standardizing bodies there has been real accomplishment in several subjects. Of special interest, on account of its relation to the use of specifications in the development of foreign trade, is the first Pan-American Conference on the Uniformity of Specifications, which was held in January, 1925, in Lima, Peru.

Standard Practice Instructions

By Paul M. Atkins
University of Chicago

The necessity for handing on explicit instructions for routine work—An example worked out for the details handled by a balance of stores clerk

IT IS one of the recognized goals of modern management to determine the best possible way of performing the tasks of shop and office. It is to this end that careful analyses are made and that time studies are undertaken. All these efforts result in little profit to the company making them, however, unless they are recorded in some tangible and permanent form for they are sure to be unwittingly changed by those who are to use them and their transmission from one person is certain to be inexact unless this is done.

There are various forms which a record of this kind may take and many different names by which it is called. One of the most familiar of these is the "instruction card." As developed by the late F. W. Taylor and those who have followed him, this expression has been used largely to indicate instructions for carrying on specific operations on particular orders in the shop. It represents the operation standard for an operation at a production center and, in most cases, an operation which is not routine in its nature.

From this starting point, the idea of developing standards for other tasks of a routine nature about the shop and office has been carried over. The form which such instructions take is usually somewhat different from that of the normal instruction card, though the fundamental concept is the same—the recording in permanent shape of a standard method of performing a task. Because such tasks are of a routine nature, the name "standard practice instructions" has frequently been given to the written directions for their performance.

It has been convenient to divide standard practice instructions up into two main groups. One of these groups comprises instructions for the performance of duties of a particular position, foreman, accountant, store-keeper, inspector, etc. The second group includes directions for the use of certain forms which pass from one position to another as they are used. Material issues, material credit slips, time tickets, etc., are examples of this latter class. Obviously there will be an overlapping between these two groups, the first being the basic and inclusive, the second being an auxiliary class to supplement the first and to gather together for convenient use information that is scattered through the first class of instructions.

Both classes of instructions should be the outcome of a careful study of the tasks recorded therein. It is only after the work has been thoroughly analyzed, various methods tested and what seems to be the best one discovered, that it is appropriate to set the procedure down in writing. It should be expected that the instructions so prepared will have a relatively high degree of permanency. At the same time, it must be remembered that it is usually possible to continue to make improvements, and when a better method has been devised the new instructions should be rewritten.

As a brief example is often worth more to one studying a problem than many pages of explanation, the following illustration is given of the first class of standard practice instructions. The position selected is one found in many companies. The form in which it is given has been generalized from experience with a variety of concerns and represents a procedure which, it is believed, has rather wide applicability. The organization of the instructions is one that may be easily applied in the case of positions where the work is of a routine nature, and, like the content, it has been thoroughly tested in practical use in industrial plants.

BALANCE OF STORES | REORDER POINT / QUANTITY TO ORDER | DANGER POINT | DESCRIPTION OF STORES: Iron Bracket Castings | STORES SYMBOL: SMCJ 25A

ORDERED							ON HAND								APPORTIONED				AVAILABLE—SHORTAGE		
Date	Purch. Ord. No.	Quantity Ordered	Purch. Req. No.	Date	Quantity On Order	Rec. Slip No.	Quantity Received	Unit Price	Ck.	Quantity On Hand	Quantity Issued	Ck.	Date	Order No.	Total Apportioned	Quantity Apportioned	Date	Order No.	Quantity	Available	Shortage
9/20	R7927	1000	P1265	9/27	1000										1000	1000	9/20	M523			
			P1265	9/17	470	58942	550	.035	a	530											
										30	500	a	9/20	M523	500		9/20	M523			
11/21	R8536	500	P1329	11/23	970										1000	500	11/21	M749			
				11/27	460	59458	510	.035	a	540											
		40		11/29	500														40		40
					1040	59746	360	.040	b	900											
											500	a	11/4	M523	500		11/4	M523			
											400	a	11/30	M749	200		11/30	M749			

Fig. 1—Balance card used by balance of stores clerk

MANUFACTURING ORDER

DATE NO. M523

Manufacture the following articles:

REQUIRED DATES																					
DATE																					
QUANTITY																					
ORDER WRITTEN		TOOL LISTS		MATERIAL LISTS		ISSUES		BALANCE DESK		INSTRUCTION CARDS		TIME TICKETS		ROUTE FILE							
DAY	HR.	DAY	HR.	DAY	HR.	DAY	HR.	DAY	HR.	DAY	HR.	DAY	HR.	DAY	HR.	DAY	HR.	DAY	HR.	DAY	HR.

Fig. 2—Manufacturing order form

1. Stores material of this class shall be requisitioned only on the strength of a manufacturing order, or of a material list which represents a manufacturing order, or to meet shortages caused by waste in manufacture, or other unforeseen causes.

2. *Apportioning Material.* Each kind of stores of this class shall be apportioned on the balance of stores card on which a record of the material is maintained, in the following manner:

(a) Make the following entries in the "Apportioned" section of the balance card (Fig. 1) in blue or black ink on the first line which has no entries on it in any section of the card.

(b) Enter the date of the manufacturing order authorizing the purchase of this material in the "Date" column, the manufacturing order number in the "Order No." column, the quantity of material to be apportioned in the "Quantity Apportioned" column, and add the same quantity in the "Total Apportioned" column. Initial the manufacturing order (Fig. 2) and date it in the space marked "Balance Desk" to indicate that the apportioning has been done.

3. *Requisitioning Material.* The material is to be requisitioned by means of a purchase requisition which is sent to the Purchasing Department. Such requisitions, unless they are emergency requisitions, are to be retained on the balance clerk's desk until 11:30 in the morning and 4:30 in the afternoon; they shall then be enclosed in internal communication envelope and sent through the plant mail system to the Purchasing Department.

(a) Make out the purchase requisition (Fig. 3) as follows: Enter date (current) in "Date" space, quantity requisitioned in "Quantity" space, symbol of material in "Symbol" space, name or description of material in "Description" space adding specification number, if any, and attaching any blueprints, bins of material, etc., which come to the desk attached to the manufacturing order for this purpose; enter the quantities wanted at certain dates and the dates when wanted in the "Date—Quantity" spaces, initial the requisition and check all entries.

(b) Make the following entries in the "Ordered" section of the balance card in blue or black ink on the same line as the entries just made in the "Apportioned" section:

(c) Enter the current date in the "Date" column, the purchase requisition number in the "Purch. Req. No." column, the quantity requisitioned in the "Quantity Ordered" column, and add the same quantity in the "Quantity on Order" column.

NOTE: The quantity requisitioned is normally the same as that apportioned, and hence no entry is needed in the "Available—Shortage" section. If, under the direction of the chief balance clerk, more material is requisitioned than is apportioned the excess must be entered in the "Quantity" column of this section; if there is a quantity shown in the "Available" column, this excess shall be added thereto; if there is a shortage shown in the "Shortage" column, this excess shall be deducted therefrom.

If, under the direction of the chief balance clerk, less material is requisitioned than is apportioned, the shortage must be entered in the "Quantity" column of this section; if there is a quantity shown in the "Available" column, this shortage shall be deducted therefrom; if there is a shortage in the "Shortage" column this additional shortage shall be added thereto.

All of these entries shall be made on the same line as the entries in "Ordered" and "Apportioned" sections.

4. *The Purchase Order.* When the copy of the purchase order covering the material for any purchase requisitioned comes to the balance desk the following entries shall be made on the balance card for the material in question, the purchase order initialed in the "Balance Desk" space to indicate that this has been done, and the purchase order sent to the Receiving Department.

(a) Find the entry made when the material was requisitioned by reference to the purchase requisition number, and in the "Ordered" section on the same line with this entry enter the purchase order number in the "Purch. Ord. No." column, and the date in the right hand "Date" column of this section.

NOTE: The quantity ordered is normally the quantity requisitioned. If it is not, call the attention of the chief balance clerk to this fact. After he has verified the correctness of this change, make the following entries on the first line which is unused in both the

"Ordered" and "Available—Shortage" sections if more has been ordered than requisitioned:

(a) Enter the excess of the quantity ordered over the quantity requisitioned in the "Quantity Ordered" column of the "Ordered" section, add this quantity in the "Quantity on Order" column, enter the purchase order number in the "Purch. Ord. No." column, and the date in the right hand "Date" column of this section.

(b) Enter the excess quantity on the same line in the "Quantity" column of the "Available—Shortage" section; if there is a quantity shown in the "Available" column, this excess shall be added thereto; if there is a shortage shown in the "Shortage" column, this excess shall be deducted therefrom.

If less material has been ordered than was requisitioned and the chief balance clerk has ascertained that no more is to be ordered on the strength of this requisition, then the following entries must be made on the first line which is unused in both the "Ordered" and "Available—Shortage" sections:

(c) Enter the shortage quantity of material ordered under the quantity requisitioned in the "Quantity Received" column of the "Ordered" section, deduct this quantity in the "Quantity on Order" column, enter the requisition number in the "Purch. Req. No." column, and the current date in the right hand "Date" column.

(d) Enter the shortage on the same line in the "Quantity" column of the "Available—Shortage" section; if there is a quantity shown in the "Available" column, this shortage shall be deducted therefrom; If there is a shortage shown in the "Shortage" column, this additional shortage shall be added thereto.

5. *The Receipt of Material.* Two copies of the receiving slip (Fig. 4) will come to the balance desk—the first copy from the Purchasing Department, the carbon copy from the Stores Department. These two copies should be sorted together and no entry should be made on the balance card until both copies have been received. All information concerning the material which has been received shall be taken from the carbon copy of the receiving slip except the unit price which shall be taken from the original. The following entry shall be made on the first line which has available space in both the "Ordered" and "On Hand" sections:

(a) Enter the quantity actually received in stores in the "Quantity Received" column of the "On Hand" section and deduct it in the "Quantity on Order" column of the "Ordered" section. Enter the purchase order number in the "Purch. Ord. No." column, the date received in the right hand "Date" column of this section, and receiving slip number in the "Rec. Slip No." column.

(b) Enter the unit price in the "Unit Price" column, and add the quantity received in the "Quantity on Hand" column of the "On Hand" section. Initial both copies of the receiving slip in the space, "Balance Desk," and give them to the chief balance clerk.

NOTE: When all the material which is expected upon a purchase has been received, the Receiving Department will send its copy of the purchase order to the balance desk. Check all entries of the receipts of material on this order which have been made on the balance card therefor and reconcile any differences between the entries for receipts on the balance card and those on the purchase order, calling on the chief balance clerk for aid, if necessary. The receiving slip numbers will furnish the means for identifying the entries.

When all the entries have been reconciled, total the receipts and note any difference between this total and the quantity ordered. If more material has been received than was ordered make the following entries on the first line which has available space in both the "Ordered" and "Available—Shortage" section:

(a) Enter the excess of the quantity received over the quantity ordered in the "Quantity Ordered" column of the "Ordered" section, and add the excess in the "Quantity on Order" column. Enter the purchase order number in the "Purch. Ord. No." column and the date in the right hand "Date" column.

(b) Enter the excess in the "Quantity" column of the "Available—Shortage" section; if there is an available quantity shown in the "Available" column, add the excess thereto; if there is a shortage shown in the "Shortage" column, deduct this excess therefrom.

If less material has been received than was ordered,,

PURCHASE REQUISITION NO. R 7927

DATE

SYMBOL	QUANTITY	DESCRIPTION

REQUIRED DATES

DATE										
QUANTITY										

MATERIAL REQUISITIONED		MATERIAL ORDERED	
DATE	SIGNATURE	DATE	PURCH. ORD. NO.
BAL. DESK			

Fig. 3—Purchase requisition form

make the following entries on the first line which has available space in both the "Ordered" and "Available—Shortage" sections:

(c) Enter the shortage of material received under the quantity ordered in the "Quantity Received" column of the "On Hand" section and deduct it in the "Quantity on Order" column of the "Ordered" section. Enter the purchase order number in the "Purch. Ord. No." column, and the date in the right hand "Date" column.

(d) Enter the shortage in the "Quantity" column of the "Available—Shortage" section; if there is an available quantity shown in the "Available" column, deduct this shortage therefrom; if there is a shortage shown in the "Shortage" column, add this shortage thereto.

Initial the copy of the purchase order in the space, "Balance Desk" and send it to the Purchasing Department, putting all purchase orders so checked during any half day in a single envelope.

Three Requisitions

6. *The Issue of Material.* Material can be withdrawn from the Stores Department only on the authority of a written material issue. There are three kinds of issues—(1) stores issues (Fig. 5) calling for a single kind of material, (2) worked material issues calling for a single kind of material, and (3) group issues calling for two or more items of material, stores, worked material or both. All items of stores material are handled alike at the balance desk regardless of what kind of issue the information comes on. When an issue calling for stores material comes to the balance desk make the following entries on the first line which has available space, in both the "On Hand," "Apportioned," and "Available—Shortage" column:

(a) Enter the quantity actually issued (in many cases this may not be exactly the same as the quantity called for or apportioned) in the "Quantity Issued" column of the "On Hand" section and deduct it in the "Quantity on Hand" column. Enter the date in the "Date" column and the manufacturing order number in the "Order No." column.

(b) If the material is indicated on the issue as apportioned deduct the quantity apportioned in the "Total Apportioned" column. Enter the date in the "Date" column and the manufacturing order number in the "Order No." column.

(c) If there is a difference in amount between the quantity issued and the quantity apportioned, enter this difference in the "Quantity" column of the "Available—Shortage" section. If the quantity issued is in excess of the quantity apportioned, deduct this excess in the "Available" column, if there is a quantity available, or add it in the "Shortage" column if there is a shortage already existing.

(d) If the material has not been apportioned, enter the entire quantity issued in the "Quantity" column of the "Available—Shortage" section and deduct in the "Available" column, if there is a quantity available, or add it in the "Shortage" column, if there is a shortage already existing.

(e) In all cases price the material which has been issued. In the "Unit Price" column of the "On Hand" section is found the unit price for each quantity of material which has been received, and between it and the "quantity received" column a "check" column. The price for material when it is issued is taken from the unit price column for the first unchecked price. This price is entered on the issue in the "Price" column and a lower case letter is entered in the left-hand "Ck." column against the price and quantity received and the same letter is also put in the right hand "Ck." column against the entry for the quantity issued. If less material is issued than the quantity received for the price taken the amount remaining unapplied of the quantity received is recorded in pencil in the same space and circled. It must be applied before the next receipt of material is applied against an issue. If the quantity issued is greater than the quantity received which is being drawn upon, some or all of the next quantity received is used. If the price is the same for both receipts, the same check mark is used. If the price is different, the quantity issued as shown on the issue must be divided into two parts and the correct price shown against each. Two different lower case letters are then employed to check the use of two different prices, both of them being recorded in the left hand "Ck" column against the entry for the material issued.

Credit Returned Material

7. *The Return of Unused Material.* When material which has been issued to the shop is not used on the order for which it was issued it is returned to the Stores Department. A record of this return is made on a credit slip which is entered on the balance card. The entry is made on the first line which has available space in the "On Hand" and "Available—Shortage" section as follows:

(a) The quantity returned is entered in the "Quantity Received" column of the "On Hand" section and is added in the "Quantity on Hand" column. It is priced in the "Unit Price" column at the last price for material received from vendor. The date is entered in the "Date" column and the manufacturing

RECEIVING SLIP NO. S 8942

RECEIVED FROM:- VIA

SYMBOL	QUANTITY	DESCRIPTION

NO. OF PKGS.	UNPACKED BY	INSPECTED BY	PURCH. ORD. NO.	BALANCE DESK	QUANT. ACCEPT.	QUANT. REJECT.	REASON

Fig. 4—Receiving slip

order number is entered in the "Order No." column.

(b) The quantity returned is entered in the "Quantity" column of the "Available—Shortage" sections; it is added in the "Available" column if any quantity is already entered there, or it is deducted in the "Shortage" column if there is a shortage shown.

8. *Shortages.* There are times when it is desirable to

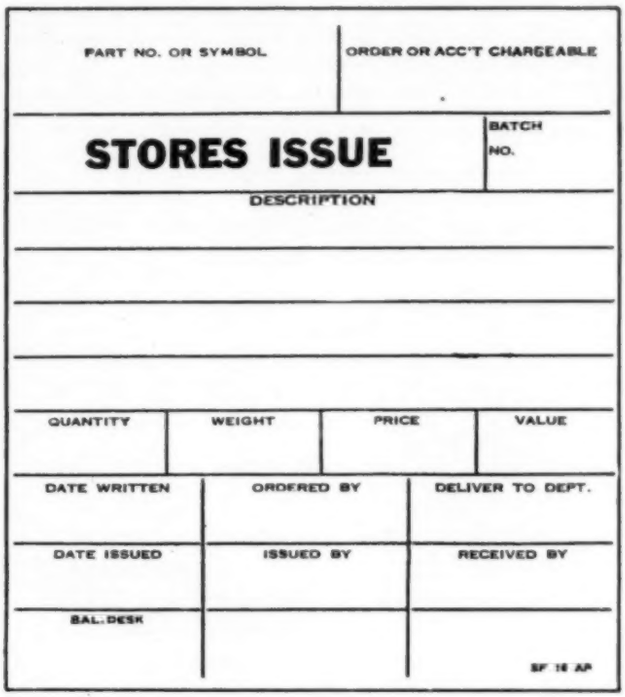


Fig. 5—Stores issue slip

allow shortages to accumulate for a time in order to allow requisitions to be placed for economical quantities or for other reasons. All balance cards on which shortages are shown must be marked with a red flag and a report thereof given each day to the chief balance clerk. The writing of a requisition to cover shortage must be done only under the supervision of the chief balance clerk.

9. *Checking of All Material Vouchers.* All material vouchers which come to the balance desk—purchase orders, receiving slips, issues, credit slips, etc.—must be checked by the balance clerk through whose hands they pass for the correctness of quantities, dates, order numbers, and any other items concerning which the balance clerk may have information sufficient to enable him to detect the possibility of error. All vouchers which *appear* to be incorrect to the balance clerk shall be given by him to the chief balance clerk with the apparent discrepancy noted. The service which the balance clerk can render in catching mistakes before they have gone far enough to do much harm is great. It depends largely on his diligence, attention to details, understanding of work, good judgment and desire to promote the general welfare of the company.

10. If any of these distinctions do not appear to be clear or if any matters come to the balance clerk which are not covered by these standard practice instructions, he should ask assistance at once of the chief balance clerk and act as he directs. He will be held responsible for any errors of omission or commission due to failure on his part to seek information concerning anything about which he has not received instructions.

Seen and Heard

By John R. Godfrey

Ethics and the selling of machinery

I WISH those who may have the idea that all machinery dealers are a hard-boiled, mercenary lot, could have been with me a few weeks ago. I was talking with the manager of a large establishment that had recently lost the agency for a well-known machine. Not through any fault of its own but because the new financial interests in the machine-building firm couldn't see why these dealers should get a commission on the sales in their territory.

The exasperating factor in the case was that the dealer had been largely instrumental in building up a demand for the machine, aided, of course, by the demonstrators and men from the factory. And yet, the dealer wasn't nearly as peeved as might have been expected under the circumstances. Furthermore he treated me to as good a dose of business ethics as I've heard in a long time.

"We're sorry to lose the account, of course, and we've been approached by others who believe they have a machine 'just as good' as the one we've lost. We don't agree with them—and until we are convinced another machine will be better for the customer, we don't sell any in that line.

"We've had builders offer to duplicate the machine as nearly as the patent law made it safe—but that sort of pirating doesn't interest us. In fact, we believe it would be a bad thing for the industry in general, and for our customers in particular, to encourage a new builder in a limited field.

"We've been in business a good many years and I believe we've built up a clientele that depends on us to give them the best machinery obtainable for their purpose. Trying to get 'even' with a manufacturer by giving our customer a substitute machine, isn't our idea of service. And revenge never pays in the long run."

Doesn't sound very hard-boiled, does it? Dealers who work on such a basis are a benefit both to manufacturers and customers.

This question of dealers and their commissions is likely to be a source of argument for many moons. When a new concern puts a machine on the market it welcomes orders from agents, or any one else, and pays commissions without a murmur.

But when the machine gets to be better known and the commissions total up into bigger figures, the drawing of commission checks becomes a more painful operation. And when the man with the check book happens to be an outsider who has come into business since the dealers built up the foundation for sales, commission checks can be extracted only by the use of an anesthetic. There is much to be said on both sides of the question—but the dealer has his side as well as the builder.

If the builder has to do all the selling by sending his "sales engineers" all over the country, he naturally feels that a full commission is not earned by the dealer. And no dealer can be expected to maintain special service men for each machine he sells. On the other hand, the dealer is in a position to give leads as to possible customers that may easily lead to sales, and this service alone is worth real money—if not a full commission.

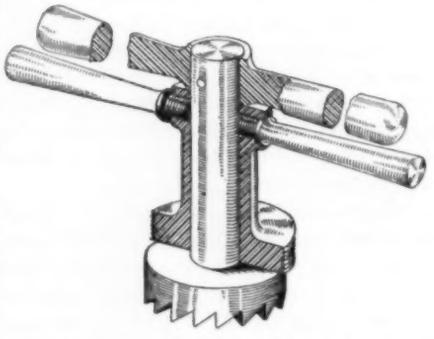
Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit.

Tool to Face Seats on Packing Nuts

By Mack Masters

Herewith is a sketch of a tool to face the seats of packing nuts, or glands, on air compressors that use metallic rod packing. In my experience with this kind of packing I find it necessary to have the bottom of the nut true and smooth, and after trying to true it up on a lathe I find this method produces better results with less trouble to apply. You will notice that the guide for the cutter has a large threaded end to fit the nut snugly. It is screwed down into the nut by means of the lower handles until the cutter touches the bottom of the nut, then the cutter is rotated by means of the upper handles while it is at the same time fed down with the lower handles.



Facing tool for packing nuts

The cutters are about $\frac{1}{4}$ in. smaller than the inside of the nut, so the filler ring rests upon its original seat. We have reduced our packing troubles one-half by the use of this device.

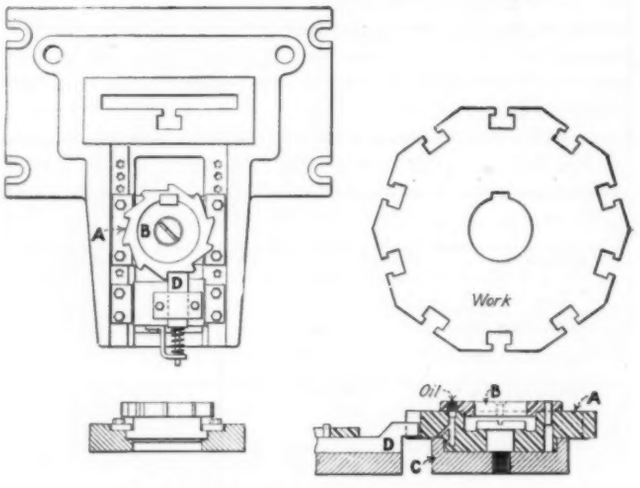
An Indexing Fixture for a Press

By G. Widen

In reading the *American Machinist* the writer has at various times found ideas and suggestions for indexing fixtures to be applied to press-work, some of which we have tried out. The accompanying drawing shows a fixture that we have designed and used with success for the purpose of indexing to notch the periphery of laminated spiders, in cases where the volume of production did not warrant the making of tools to stamp the piece complete.

The index plate *A* can be of any size within the limits of the piece to be notched, and can have any required number of steps. An adapter plate *B* is made to fit the bore of the stamping to be notched, and by making a plate for each kind of work the fixture may be adapted to any piece, the size of which is within its range. It is adjustable to and from the die, and can be clamped in any position to accommodate different diameters.

Various index plates may also be made, to be interchangeable in the base *C* of the fixture. The engaging block *D* is very heavy and is hardened and ground. It is well supported and furnishes a very positive stop. The index plates may be scraped to any required degree of accuracy; which is not difficult to do, since there are only the radial faces of the notches to be scraped.



Index fixture to notch stampings

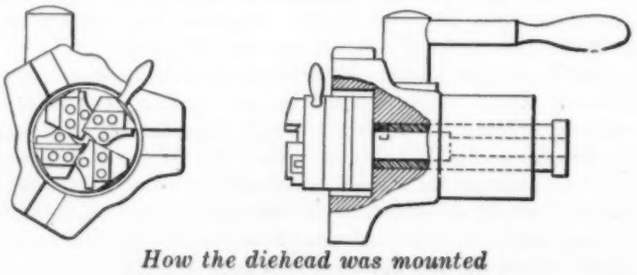
Work is easily held within limits of ±0.002 in. on stampings that measure 18 in. across the flats, since the stamping is held directly upon the index plate and there is no lost motion or backlash.

The fixture is readily adaptable to a large range of sizes, and since there are no levers to be removed in or out—the operator having only to advance the index plate to the next notch and trip the press—it is a time-saver.

Small Diehead Adapted to Large Turret Lathe

By J. R. Weigel

The sketch shows an adaptation of a diehead for cutting threads of small diameter on a large machine, in this case a Jones & Lamson flat turret lathe.



How the diehead was mounted

The holder for the centering tool, which is a part of the regular equipment of the machine, was bored at the large end to allow the diehead to operate freely, while the spindle was bored to take the shank of the diehead, as shown.

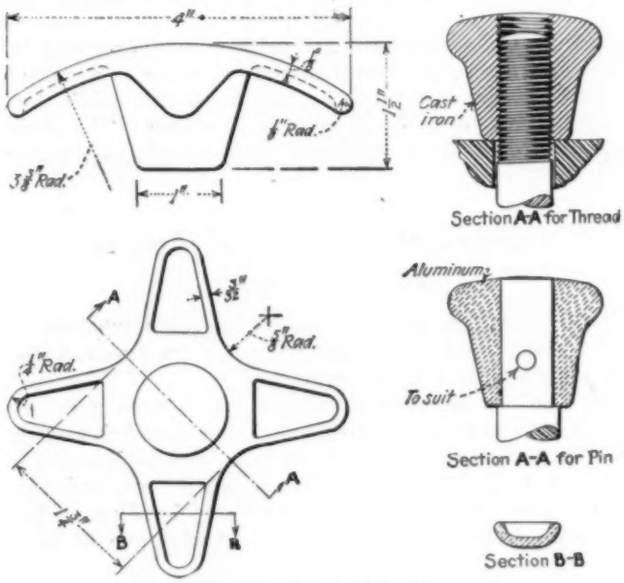
Since the centering tool was arranged to traverse on the spindle by means of a rack and pinion operated by a lever, it is obvious that the diehead could be used without hand-feeding the heavy turret.

The diehead will thread work of from $\frac{1}{4}$ to $\frac{3}{8}$ in. diameter, and threads can be cut up to 3 in. in length. The ease by which the device can be operated, permits the cutting of threads that are as perfect at the start as at the finish.

Hand Knobs for Jigs and Fixtures

By Frank Waldo

A great many hand knobs provided for jig and fixture work are small in size and so shaped that the operator has difficulty in using them to apply or release the required pressure. A small hand knob is hard to



Details of hand knob

"grip" and a poorly-shaped one is hard to turn. Then, there is the knob that is too thin to afford proper finger clearance for easy operation.

Considering these objections, the hand knob shown in the illustration was designed for tool work for use wherever "husky" pressure was required. It is large enough to permit a firm hold, it is shaped to offer a good grip for turning, and it is thick enough to lessen the chances of skinning the knuckles, especially when used in close quarters.

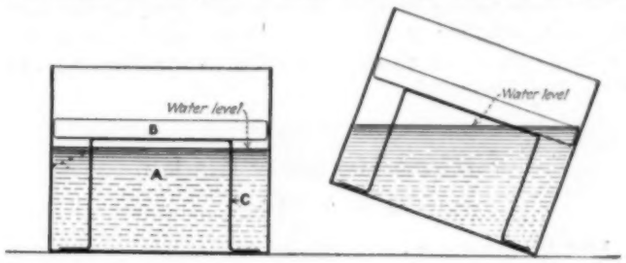
The knob should be made of aluminum when it is to be held on a shaft by a pin, and of cast iron when a threaded member is to be used. The sizes shown may be varied slightly, if desired, for either larger or smaller knobs although it is recommended to maintain the general size in order to meet the requirements mentioned.

Local Annealing

By H. Moore

A lot of round steel pins, $\frac{3}{16}$x6 in., hardened all over, was sent to us to be annealed in the center only, to permit a further machining operation. The hardness of the pins had to be maintained for at least 1½ in. at each end.

We decided to use an acetylene torch for heating and a specially fitted-up tank for quenching. The tank *A* was made so the pins *B* fitted it nicely, lengthwise, and



Tank arranged to prevent softening the ends of the pins

was provided with a false bottom, or support, for the pins, as at *C*. The tank was filled with water to within a short distance of the top of the false bottom.

While the torch flame was being applied, the pins were rolled back and forth by a rod to insure even distribution of the heat. As soon as the color began to run toward the ends, the tank was tipped, first to one side and then to the other, so that the water flowed over the ends and cooled them.

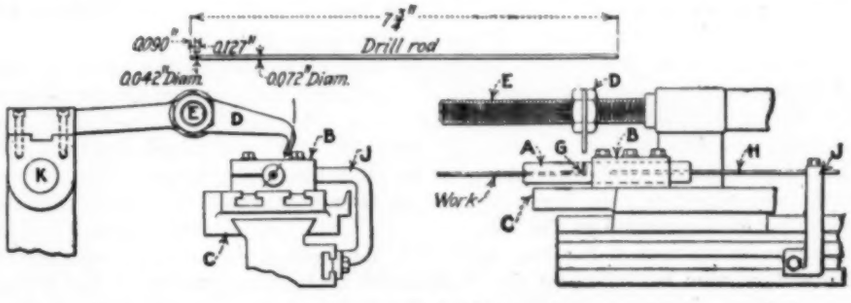
Special Screw Machine Set-Up

By H. J. Boll

Owing to the small diameter of the groove and the length of the piece shown herewith, it was found necessary to make a special screw machine set-up for doing the work. The accompanying sketch shows how this was done. The machine used was a Cleveland ⅜-½, Model B.

The main requirements were: A steady rest for the right-hand end of the work, so that centrifugal force would not break off the piece in the 0.042-in. diameter groove. An ejector, to remove the work thus supported from the steady rest. A guide or pilot for the ejector, on account of its small diameter and the vibration of the machine. A special stock stop to work in connection with the ejector.

The steadyrest *A* is a long bushing held in the clamp *B* on the work slide *C*. The stop *D*, which is mounted as shown on the stop shaft *E* is made of sheet steel and



Ejector for slender work

is shaped to enter the slot *G* in the bushing *A* as it swings down behind the work. The ejector *H* is introduced into the bushing *A* and is supported by the clamp bracket *J*, which in turn is attached to the bed of the machine. The stop shaft *E* is supported from the camshaft bearings *K*, as shown.

As the work slide travels to the right, after the work has been formed and cut off, the ejector, being stationary, pushes the work from the steadyrest.

If a large quantity or several sizes are to be produced, this bushing may have smaller hardened bushings of the right size placed in its ends.

The hole in the bushing *A* naturally goes all the way through, but this is not shown in the sketch, in order to illustrate more clearly the relative positions of the work and the ejector.

Nicked Hacksaw Blades

By D. A. Rogers

One of the common faults of the ordinary hacksaw is the liability of the teeth to break. A blade having several teeth broken out in one spot is generally scrapped, because if any attempt is made to use it, the

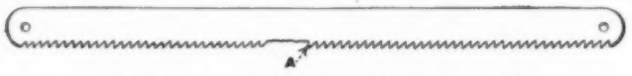


Fig. 1—Saw blade with broken teeth

tooth at *A*, Fig. 1, will have to take a bite equal to its length and will likely be broken by the shock. The next tooth will follow suit, and so on until the majority of the teeth have broken. If a blade having a few broken teeth is placed over a grinding wheel as in Fig. 2, and the first three teeth ground so they will be, respectively, $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{3}{4}$ of their normal length, its useful life will be considerably lengthened.

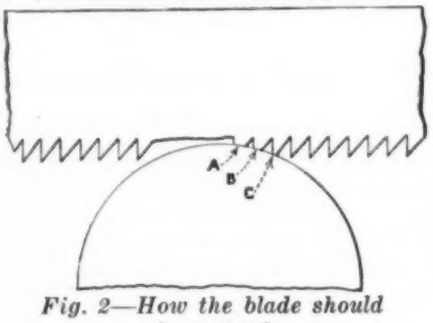


Fig. 2—How the blade should be ground

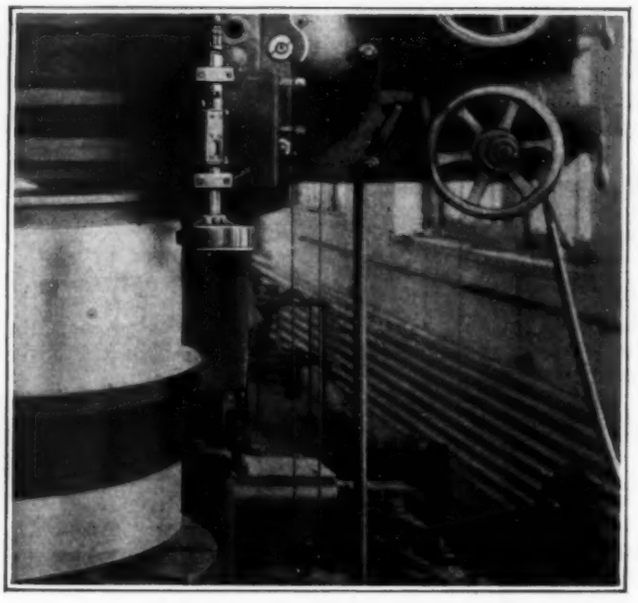
When a blade so ground is in use, the nicked portion will slide over the work, allowing the following teeth to come into use in a normal manner.

Portable Grinder Used on a Boring Mill

By H. P. Bailey

We had to machine a 51-in. cast-iron drum and the work was done on a 5-ft. Bullard vertical boring mill, as shown in the illustration. After the roughing cut had been taken on the outside diameter several blowholes were discovered in the surface. Since this surface had to be smooth, the blowholes were filled by welding. In attempting to take the finishing cut, it was found that the welded spots were so hard the tool would not stand up, so we were forced to resort to other means for finishing the job.

Having a Warner & Swasey, type D-1, roto grinder on hand, it was mounted on the right-hand toolholder by two steel clamps, notched to suit the body of the



How the grinder was used

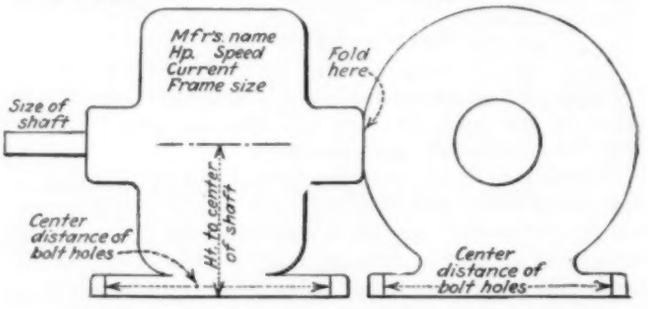
grinder. The boring mill and grinder were operated in clockwise direction, two cuts being taken. A wheel of soft grade was used for the first cut, while the finishing was done by a very hard wheel. The slide was protected from abrasive dust by placing paper around it.

Cardboard Templets of Motors

By H. M. Darling

In making the layout of a motor-driven machine, I find it convenient to try the location of the motor, without drawing its outline on paper.

Having considerable of such work, I have a set of cardboard templets, showing the side and end elevations of such motors as we commonly use. A templet of this kind can be laid on the drawing of a machine, and give a very good idea of its appearance and location on the finished product. Or a full-sized templet can be used



Templet giving two elevations of motor

in the shop, by holding it in position on a machine to show the location of a motor.

A templet of this kind is first drawn on heavy cardboard, and then cut out, with the side and end elevations hinged together, as shown in the illustration.

On the cardboard templets, I write the maker's name, frame size of the motor, horsepower, speed, current, principal dimensions, and other information. After using, I file it away for future use, when adopting motor drive to some other machine.

Sizes of Standard Milling Cutters (Simplified Practice)

Involute Gear Cutters for Miter and Bevel Gears

Standard Hole, Standard Keyway

Diametral Pitch	Diameter of Cutter: Carbon Steel	Diameter of Cutter: High-Speed Steel	Size of Hole	Diametral Pitch	Diameter of Cutter: Carbon Steel	Diameter of Cutter: High Speed Steel	Size of Hole
3	4	4	1¼	10	2¼	2⅜	⅞
4	3½	3⅝	1¼	12	2⅛	2¼	⅞
5	3¼	3⅜	1¼	14	2	2⅛	⅞
6	3	3⅛	1	16	2	2⅛	⅞
7	2⅞	2⅞	1	20	1⅞	2	⅞
8	2⅞	2⅞	1	24	1¾	1¾	⅞

⅝-in. Hole, ½ x $\frac{1}{16}$-in. Keyway

Diametral Pitch	Diameter of Cutter: Carbon Steel	Diameter of Cutter: High-Speed Steel	Diametral Pitch	Diameter of Cutter: Carbon Steel	Diameter of Cutter: High-Speed Steel
4	3⅜	3⅛	8	2¾	2⅞
5	3⅛	3¼	10	2⅝	2⅝
6	3	3⅛	12	2½	2½
7	2¾	2⅞			

Involute Gear Cutters

[Involute gear cutters can be sharpened without changing their outline]

Eight cutters are made for each pitch, as follows: No. 1 will cut wheels from 135 teeth to a rack; No. 2 will cut wheels from 55 teeth to 134 teeth; No. 3 will cut wheels from 35 teeth to 54 teeth, No. 4 will cut wheels from 26 teeth to 34 teeth; No. 5 will cut wheels from 21 teeth to 25 teeth; No. 6 will cut wheels from 17 teeth to 20 teeth; No. 7 will cut wheels from 14 teeth to 16 teeth; No. 8 will cut wheels from 12 teeth to 13 teeth.

Standard Hole, Standard Keyway

Diametral Pitch	Diameter of Cutter: Carbon Steel	Diameter of Cutter: High-Speed Steel	Size of Hole	Diametral Pitch	Diameter of Cutter: Carbon Steel	Diameter of Cutter: High-Speed Steel	Size of Hole
*1	8½	8½	2	12	2⅛	2¼	⅞
*1¼	7¾	7¾	2	14	2	2⅛	⅞
*1½	7	7	1¾	16	2	2⅛	⅞
1¾	6½	6½	1¾	18	1⅞	2	⅞
2	5¾	5¾	1½	20	1⅞	2	⅞
2½	5½	5¾	1½	22	1⅞	2	⅞
3	4⅜	4¾	1¼	24	1¾	1¾	⅞
4	3⅞	4¼	1¼	26	1¾	1¾	⅞
5	3⅝	3¾	1¼	28	1¾	1¾	⅞
6	3	3⅛	1	30	1¾	1¾	⅞
7	2⅞	2⅞	1	32	1¾	1¾	⅞
8	2⅞	2⅞	1	36	1¾	1¾	⅞
9	2¾	2¾	1	40	1¾	1¾	⅞
10	2¼	2⅜	⅞	48	1¾	1¾	⅞
11	2¼	2⅜	⅞				

Note.—Cutters marked * are not kept in stock, but are made to order.

1-in. Hole, $\frac{5}{32}$ x $\frac{5}{64}$-in. Keyway

Diametral Pitch	Diameter of Cutter: Carbon Steel	Diameter of Cutter: High-Speed Steel	Diametral Pitch	Diameter of Cutter: Carbon Steel	Diameter of Cutter: High-Speed Steel	Diametral Pitch	Diameter of Cutter: Carbon Steel	Diameter of Cutter: High-Speed Steel
4	3½	3⅝	9	2¾	2¾	16	2½	2½
5	3¼	3⅜	10	2¾	2¾	18	2⅜	2⅜
6	3	3⅛	11	2⅝	2⅝	20	2⅜	2⅜
7	2⅞	2⅞	12	2⅝	2⅝	22	2¼	2¼
8	2⅞	2⅞	14	2½	2½	24	2¼	2¼

1¼-in. Hole, $\frac{3}{16}$ x $\frac{3}{32}$-in. Keyway

Diametral Pitch	Diameter of Cutter: Carbon Steel	Diameter of Cutter: High-Speed Steel	Diametral Pitch	Diameter of Cutter: Carbon Steel	Diameter of Cutter: High-Speed Steel
3	4⅜	4¾	8	3¼	3¼
4	3⅞	4¼	9	3½	3⅜
5	3⅝	3¾	10	3	3
6	3½	3½	12	2⅞	2⅞
7	3⅜	3⅜			

1⅜-in. Hole, $\frac{3}{16}$ x $\frac{3}{32}$-in. Keyway

Diametral Pitch	Diameter of Cutter: Carbon Steel	Diameter of Cutter: High-Speed Steel	Diametral Pitch	Diameter of Cutter: Carbon Steel	Diameter of Cutter: High-Speed Steel
2	5¾	5¾	4	4¼	4½
2½	5½	5¾	5	4	4¼
3	5	5¼	6	3¾	3⅞

1⅞-in. Hole, ⅜ x $\frac{3}{16}$-in. Keyway

1¾	6½	6½	4	4⅝	4¾
2	6½	6½	5	4⅜	4⅜
2½	5⅞	6⅛	6	4¼	4¼
3	5⅜	5⅝			

Involute Gear Cutters, Large Diameters

1½-in. Hole, $\frac{3}{16}$ x $\frac{3}{32}$-in. Keyway

Diametral Pitch	Diameter of Cutter	Diametral Pitch	Diameter of Cutter	Diametral Pitch	Diameter of Cutter
2	5	6	3½	10	3½
3	4¾	7	3½	12	3½
4	4	8	3½		
5	3½	9	3½		

1⅝-in. Hole, ⅜ x $\frac{3}{16}$-in. Keyway; 2-in. Hole, ½ x $\frac{3}{16}$-in. Keyway

Diametral Pitch	Diameter of Cutter: Carbon Steel	Diameter of Cutter: High-speed Steel	Size of Hole	Diametral Pitch	Diameter of Cutter: Carbon Steel	Diameter of Cutter: High-speed Steel	Size of Hole
1	8½	8½	1½ or 2	4	5¼	5¼	1½ or 2
1¼	7¾	7¾	1½ or 2	5	5¼	5¼	1½ or 2
1½	7¼	7¼	1½ or 2	6	4¼	4¼	1½ or 2
1¾	6¾	6¾	1½ or 2	7	4¼	4¼	1½ or 2
2	6¼	6¼	1½ or 2	8	4¼	4¼	1½ or 2
2¼	6¼	6¼	1½ or 2	10	4¼	4¼	1½ or 2
2½	6¼	6¼	1½ or 2	12	4¼	4¼	1½ or 2
2¾	5¾	6¼	1½ or 2	14	4¼	4¼	1½ or 2
3	5¼	5¼	1½ or 2	16	4¼	4¼	1½ or 2

Corner-Rounding Cutters

[Corner-rounding cutters will be furnished in right or left hand single style. They have formed teeth and can be sharpened without changing their outline]

Radius of Circle	Diameter of Cutter	Size of Hole	Radius of Circle	Diameter of Cutter	Size of Hole
⅛	2	⅞	½	3¼	1
¼	2¼	⅞	⅝	3½	1
⅜	3	1			

(To be concluded)

Punch here to suit your binder

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Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

An Inspection Pitfall

Q. We manufacture a number of parts in separate departments and also progressively through these departments to a final assembly. Regardless of the fact that we have a trained inspection force distributed through these departments, we get, what we believe to be, too many defective parts to the assembly. From there they have to be scrapped or returned for correction. On checking back, we find that, in nearly every case, these defective parts have been passed by the inspector under no pressure from production. Perhaps you can give us a clue to the trouble that we have been unable to find. Changing inspectors seems to do no lasting good. They are not answerable to any man on the production side.

A. There is a certain practice in connection with inspection work that is a common source of the trouble you outline. Its correction may be the solution for your difficulty.

When an inspector finds a run of defective work it is his human tendency to question its cause and come to some conclusion in his own mind as to what should be done by way of correction. When he reports the necessity of stopping production to the department foreman and exhibits the defective work the first question that occurs to the latter is in line with what he should do to get under way again. Naturally he must make a correction of some kind to stop the defective work and it is only natural that he ask the inspector what he can suggest.

The inspector is thereby led unintentionally into a pitfall. He will, more than likely, suggest what he thinks is the remedy. The foreman puts the suggestion into effect and then looks to the inspector to pass favorably on the result. There are very few men who will have the courage to refuse even after they find their suggestions were wrong.

In your case, establish the hard and fast rule that the inspector will have nothing to say as to remedies for defective work and see if your difficulty does not largely disappear.

Breaking High-Carbon Bars Instead of Cutting Them

Q. We have some work to do that involves cutting a large number of short lengths of high-carbon steel from 3½-in. bars. We can saw them but want to know of any other method that will not require an outlay for saws and that can be set up at a minimum of expense.

A. During the War, a method was devised of dividing high-carbon bars into short lengths, by a company manufacturing shell forgings in quantities. The method may be suitable for your work.

The bars were nicked at the required intervals by means of gas cutting torches. The nick was approximately 2 in. long across the bar fading away at both ends, was about ⅛ in. wide and of the same depth at its deepest point. The nicked bars were then passed between the jaws of an alligator shear. On the upper jaw there was secured a round-nose anvil, and, on the lower jaw, two similar anvils located about 8 in. apart and equally on each side of the upper anvil. The nick was located between these lower jaws about in the center and facing downwards. The anvils were set to exert a slight bending action in the bar and the pieces broke off readily. The fracture started at the nick and ran practically square across the bar.

If you have no shear, the work can be done in an ordinary press of sufficient strength or under a steam hammer. The shear used in the example cited was a No. 4 Doelger and Kirsten.

To Prevent Lead Sticking to Steel In a Lead Bath

Q. We use a lead bath for a heat-treating operation on steel parts and have experienced difficulty due to the lead sticking to the parts. Please tell us of a way to prevent this action.

A. The parts can be coated with a mixture of common whiting and wood alcohol. Water can be used instead of the alcohol, but, in this case, the coating must be dried thoroughly or the steam formed when the wet coating is immersed will cause the lead to splatter badly.

Eliminating the Inefficient Press-Clutch Control

Q. We operate a number of large mechanical presses, that are rather difficult to start and stop. In fact, this feature actually is the determining factor in production on a number of the parts we make, which cannot quite be fed at the speed with which the ram moves up and down. To get around this difficulty we put an additional operator on the clutch lever. Are there any mechanical devices you can suggest to shift the clutch?

A. We do not know of any complete devices, such as you mention, that are on the market, but it would be a comparatively simple matter for you to do as others have under similar conditions.

Standard air cylinders can be purchased and installed by your own mechanics, or, if air is not available, an electric solenoid can be used. The small pneumatic operating valve or the solenoid push button can be set conveniently for the operator and can be operated rapidly without diverting his attention as when he must exert all of his strength against the usually cumbersome operating lever.

In fact we believe you will agree with us that the press builders could take a step forward by eliminating this very inefficient part of the clutch-operated press which is, otherwise, adequately designed for high-production work.

Technical Abstracts

The Foremen's Opportunity

J. B. Orbison, of the American Radiator Co., points out that it is hard for the individual to admit it, yet the fact remains that very few foremen have had any training in the qualities of foremanship and leadership. They have, in most part, been allowed to drift on their own initiative and to work out their own salvation. And yet they are held responsible for the successful handling of men and affairs.

No training or general understanding of the duties and responsibilities surrounding the position has been in evidence, except in isolated cases. The whole system has been radically wrong. "Right here we may just as well get this thought clear in our minds. We can't go out and shake the industrial tree, pick up a man and drop him into a department and expect results. If there is nothing more than this to leadership, then we have been misled all these years," he says.

The system has been weak which has allowed the education of foremen to be neglected. The employer has been to blame, very true, but what about the lack of ambition on the part of foremen. The latter have developed under the impression that experience is all that is necessary, evading the fact that ability and knowledge are the fundamental requisites of successful foremanship. —*The Foremen's Magazine*, Nov., 1925, p. 16.

Arc Welding of Cast Iron

Dr.-Eng. H. Neese publishes an examination of arc welds in cast iron. He distinguishes between cold welding and hot welding. In cold welding a welding rod of soft steel is used. In order to avoid strains it is necessary to localize the heating as much as possible, and yet the nature of the weld is that of hard white cast iron and it is very unreliable. For important welds heating of the welded article is essential. The welding rod is made of cast iron. To secure a soft weld, which can be machined, the welding rod should be high in silicon—up to four per cent, and the seam should be made of large dimensions so that a slow cooling is secured.

Tests of the author show a Brinell hardness of the seam which decreases steadily with the silicon content of the rod. A somewhat more irregular softening effect is attained by titanium. To produce the large seams amperages up to 1,000 and more are necessary.—*Zeitschrift des Vereines deutscher Ingenieure*. Nov. 7, p. 1409.

Oil Locomotives

The displacement of coal and steam on railroads by oil and electricity is discussed by A. E. Heiss. An oil-electric locomotive on the Central of New Jersey line handled 431 cars in 61 hrs. 50 min. at a fuel and lubrication cost of $11.90. In the same week a coal burning locomotive handled 430 cars in 75 hours at a fuel and lubrication cost of $73.35. Conditions in the test were as nearly alike as possible. The oil-electric locomotive delivered approximately 25 per cent of the energy from the fuel to the driving mechanism, while the steam locomotive only five to seven per cent.

Co-operators in this test in addition to the railroad were the American Locomotive Co., the General Electric Co. and the Ingersoll-Rand Co. Attention of railroad managers is being directed to the oil-electric by the enormous increase in the cost of fuel since the war.—*National Petroleum News*, Nov. 25, p. 71.

Vibration

High speed, unfortunately, is invariably accompanied by more or less vibration. At times actual failures have been ascribed to it and it is important to be sure whether it can really exercise the damaging effects often attributed to it. There is, for one thing, the deep-rooted idea that vibration can cause steel to crystallize and thus to become weak and brittle. It has long since been shown that vibration has no such effect. Metals in general and steel in particular are always crystalline, and indeed the more completely and perfectly crystalline they are, the greater is their ductility and softness.

A rational view of the matter suggests that since vibration consists simply in a rapidly alternating change of shape or position of a piece of metal, its effects must be essentially those of deformation—either elastic or ultra-elastic, according to the magnitude of the deformation in question. On this view we should anticipate that vibration would have no other effect than a corresponding movement such as bending backwards and forwards through the same range.

From the present point of view, it is shown conclusively that there is no mysterious internal effect produced upon a metal by vibration apart from the ordinary alternating stresses which are set up.—*The Metallurgist (England)*, Oct. 30, p. 145.

Finding Axle Cracks

One of the most troublesome and serious forms of delay in the operation of a tramway service is that which is due to the breakage of car axles. In spite of rigid examination and the withdrawal of axles from service after running a fixed number of miles, failures do occur. In the London County Council tramway shops each axle is examined for the detection of cracks by means of a magnifying glass, but minute hair cracks develop which cannot be seen even by the aid of a reasonably powerful glass. In order to overcome this difficulty, a magnetizing machine has been designed and put into use, by means of which fine cracks can be easily discovered.

Briefly, the method is first to magnetize the axle and, when it has been magnetized, to allow to flow from the container through the flexible pipe a mixture of paraffin and iron powder with calcium chloride added to prevent the presence of any moisture. Should there be no cracks the solution will run off, but in the event of the existence of a hair crack, however small, the powder will cling to the crack and show a comparatively thick line and thus indicate its location.—*Aera*, Nov., 1925, p. 779.

American Machinist

KENNETH H. CONDIT AND FRED H. COLVIN
Editors

Established 1877

Volume 64

WITH this issue begins Volume 64 of the "American Machinist." In it you will find the best efforts of important contributors and of the hard working editorial staff. The balance of material, selected carefully to meet the needs of the various classes of readers, will not differ greatly from that of the previous issue. In one respect, however, the new volume cannot hope to equal Volume 63 which had 27 numbers because of a calendar freak that brought that many Thursdays into the last half of the year. In all other respects it should outdo its predecessors.

The editorial staff charged with the production of the paper is composed of Kenneth H. Condit and Fred H. Colvin, editors; L. C. Morrow, managing editor; A. L. DeLeeuw, consulting editor; and S. Ashton Hand, Ellsworth Sheldon, W. E. Irish, Frank W. Curtis and John Younger, associate editors.

What Do We Know About Bearings?

ALTHOUGH much experimenting has been done on bearings of various kinds there still remains plenty of room for research as to why certain conditions produce certain results. We were formerly taught that by reducing the load per square inch of projected area bearing troubles would disappear. But we frequently overlook the importance of continuous lubrication and find that it often pays to cut away part of the bearing surface in order to insure sufficient lubrication getting to the bearing. In other words, we must have an oil film and a flow of lubricant sufficient to prevent actual contact and to carry off the heat generated.

When it comes to ball bearings the condition is reversed and too much oil frequently causes heating and trouble. In fact, on some high speed bearings, a mist of oil is all that is required to keep the bearing in good shape, and a dry bearing will frequently run cooler than one with even a little too much oil.

Then, too, the old idea of projected area gets a decided jar when it runs into the type of bearing used on locomotive track axles. Here a narrow strip of babbitt, well down on each side of the journal, carries a load of several tons, with a projected area that is so small as to be almost unbelievable. There are still opportunities for research in colleges and elsewhere before we really know all the reasons for good and bad bearings.

The Trade Associations' Big Job

TRADE associations today are invaluable aids to the big companies among their membership in providing statistics on which plans for the future conduct of business can be based. To the smaller companies they are not only invaluable but practically indispensable. Where the big company with its extensive operations and large resources can conduct investigations and secure information for its own use, the little one has neither the means nor the organization to do so and must fall back on its trade association.

There are still many companies that are not convinced of the value of trade association work. They will do well to investigate the subject thoroughly because more and more depends on accurate knowledge of business conditions and hunch-playing is an increasingly dangerous pastime.

A Text for Advertisers

TELL the truth in such fashion that your hearers will accept it. Here is a text for sermons to many men in many fields, but it has particular force for those who depend on advertising to supplement their other sales efforts.

There was a time when advertisers did not feel it necessary to adhere too closely in their statements to the letter of the truth. It might be more charitable to say that enthusiasm got the better of strict observance of the truth. That day, happily, is almost spent and advertisers generally do not make statements that cannot be substantiated.

But it is not sufficient merely to make statements that are true. It is necessary to make them in such a way that the hearer will recognize them as worthy of credence and believe them instinctively.

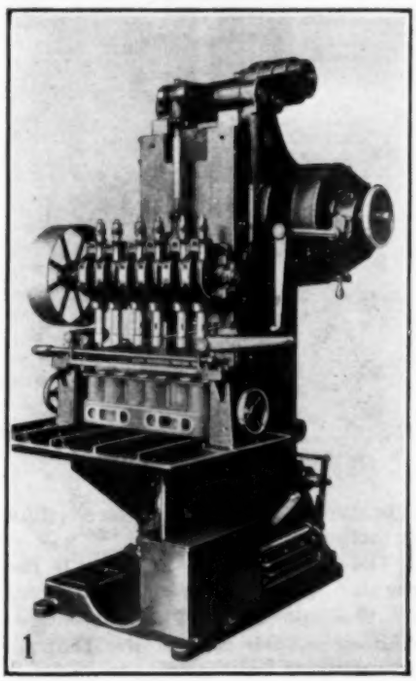
There is no formula by which advertisements can be tested to see that they meet these requirements. Much depends on the reputation of the man or company behind the statements made. This very lack of a mechanical tester makes it all the more important to study each piece of copy to make sure that what is said is true and, further, that it carries conviction.

Cost accounting is good for two things—to tell a man when to stay in business and to tell him when to get out.

Shop Equipment News

Moline Cylinder-Lapping and Boring Machine

The Moline Tool Co., Moline, Ill., is manufacturing the No. 8 lapping machine illustrated in Fig. 1, and is providing its No. 10-D cylinder borer, illustrated in Fig. 2, with an automatic "Oilgear" feed. The earlier designs of the lapping machine and of the boring machine were previously described on p. 157, Vol. 59, and p. 520, Vol. 47, of the *American Machinist*, respectively.



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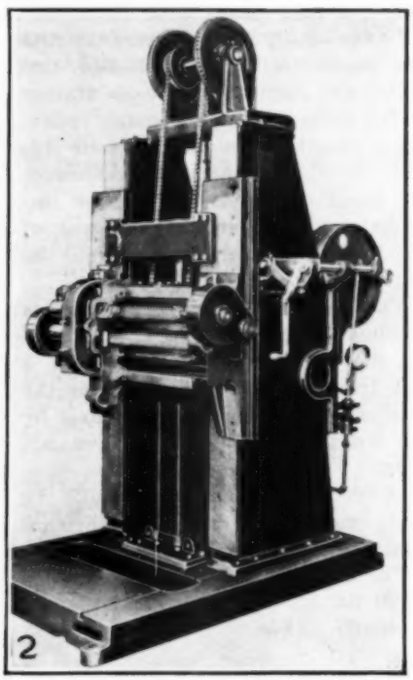

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Fig. 1 — Moline Cylinder-Lapping Machine
Fig. 2—The No. 10-D cylinder boring machine

The lapping machine has a table mounted on an adjusting screw to provide for work of various heights and has a sliding rail with automatic feed. The feed mechanism is designed to operate against the rocker arm which can be seen at the top of the illustration. On one end of the arm are counterbalance weights, and on the other is secured the adjusting screw for the rail. The downward movement of the rail is against pressure from long coil springs.

The spindles are driven through a horizontal spiral and spiral gears. They operate against ball thrust bearings. The heads that carry the spindles can be located in any position and as many as six can be carried on the rail.

The coolant is pumped through piping to the work and is then drained into a settling tank. Oil and grease cups are provided for lubricating the bearings of the machine.

The boring machine shown in Fig. 2 is in a stripped condition so that the "Oilgear" feed mechanism for the spindles can be seen. One of the spindles has been left on the machine to show the spiral gear and the horizontal spiral drive.

The hydraulic cylinder stands between the two vertical housings. The piston is connected directly to one cross-arm of the rail assembly. The flow of oil to the piston can be regulated so that the rail will descend rapidly until the spindles reach the piece, and then the feed will be at a rate suitable for the work. Counterbalance weights carry the rail, as can be seen in the illustration. A gage is provided so that the pressure applied to the arm can be observed.

Milburn Oil Burner and Preheater

The oil burner and preheater illustrated is manufactured by the Alexander Milburn Co., 1416-1428 West Baltimore St., Baltimore, Md., for use in foundries, machine and repair shops where the portability of the unit is an advantageous factor. This equipment is intended for preheating castings before welding, for heating soldering irons or to serve as burners for core ovens or annealing furnaces.

The burner is of the atomizing type and uses kerosene oil or distillate as a fuel. The equipment is provided with an air supply line. The air is maintained in the tank under a pressure varying from 50 to 100 lb., and a direct flow of air to the burner is supplied, as well as pressure to the oil storage tank.

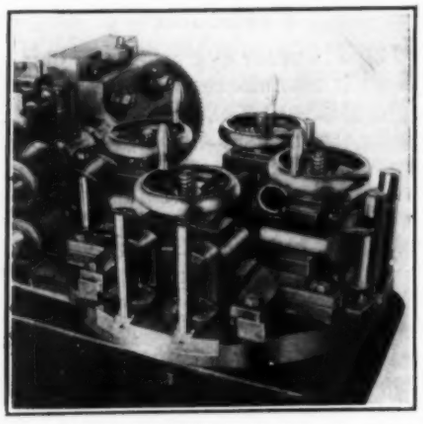
Milburn Oil Burner and Preheater

The flow of both oil and air in the burner is through straight-line orifices. The oil, under pressure, enters the atomizing chamber at right angles to the flow of air. The air passes through the center of the burner to strike the filament of oil which is atomized and then expanded in a venturi-shaped outlet.

Shop Equipment News

Bilton Two-Spindle Pro-Ducto-Matic

The machine shown in the illustration herewith is a modification of the No. 8 Pro-ducto-matic, made by the Bilton Machine Tool Co., Bridgeport, Conn., and described on page 952, Vol. 63, of *American Machinist*. It differs from the previous machine in that the two spindles are disposed in a vertical plane with relation to each other and in that the movement of the cutters to the work is horizontal instead of vertical.



Bilton Pro-ducto-matic with two spindles

The job for which it is tooled up as here shown is the opening, or cutting out, of the slots in the yokes of universal joints. There are four cutters on each of the cutter spindles, operating upon two pieces of work at each turret station. The hardened and ground studs are rigidly attached to the face of the turret and the holes, previously bored in the yokes, fit over them, thus locating the work exactly with reference to the cutters.

The bodies of the yokes rest in V-blocks, also permanently attached to the turret, and are secured by clamps that are tightened by means of the small handwheels at the top of the fixture.

The horizontal movement of the ram is brought about by a double cam on the camshaft at the rear of the machine and is positive in both directions. The spindle heads are mounted on the vertical face of the ram and are independent of each other. They have no vertical movement by power, but can be adjusted vertically by means of screws to accommodate different center distances of the work.

The spindles are driven by a common intermediate gear that meshes with the pinions on the outer end of the spindles. This intermediate gear is carried upon a horizontally adjustable stud so that compensation can be made for varying center distances. Instead of an overarm to support the spindles there are separate bearings mounted to slide vertically upon a square post that is carried by a bracket attached to the ram and and moves with it.

In the set-up here shown four cuts are made on each piece and two pieces are completed at each station of the turret. The automatic indexing mechanism provides for four stations at 90 deg. apart. The fixtures are hand operated and can be unloaded and reloaded at any one of the three idle stations that may be convenient.

The drive to the spindles is through helical gearing from a pulley that can be arranged to take a belt from an overhead shaft, or the machine can be driven as a unit by an independent motor. When arranged for shaft and belt drive, separate belts are necessary to drive the cycle movement and the lubricant pump if the latter is used.

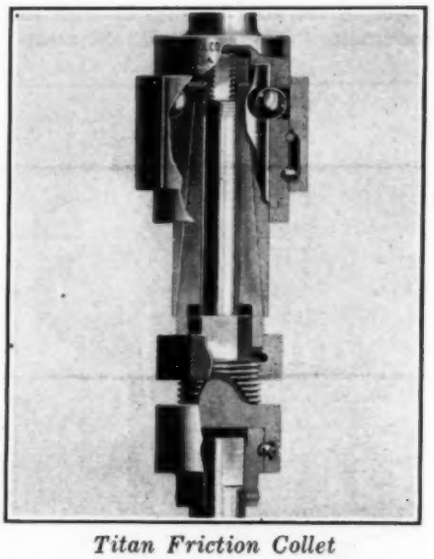
The machine weighs approximately 3,300 lb. and occupies a floor space of 42x60 inches.

Titan Friction Collets

A line of friction collets for use in tapping or stud setting is being manufactured by the Titan Tool Co., Erie, Pa. A phantom view of the collet mounted in this company's "quick-change" chuck is shown in the illustration. The collet is designed for use in connection with this type of chuck. It is held in place by means of steel balls which are, in turn, inclosed by a collar. By raising the collar, which is recessed on the inside, the collet can be removed from the chuck.

The body of the collet consists of a steel rod around which is placed a hardened steel cone. Inserted between the steel cone and the collet proper is a fiber cone providing the main friction. A hole in the base of the collet proper accommodates the upper end of the rod. Between the collet and the nut holding the rod in place are inserted key-type hardened-steel and fiber washers. Fiber washers placed on a shoulder of the rod and facing against the base of the collet can be removed, one at a time, to compensate for wear on the friction cone.

At the bottom of the rod is a hexagon interlock between the body and the cone. The adjusting nut, which is shown, is of the differential type and by means of it the friction is increased or decreased.



Titan Friction Collet

The lower part of the unit is the regular tap adapter manufactured by this company. The advantages claimed by the makers are that all adjustments can be made while the unit is set up, and that the collet will not become set from excessive thrust in starting the tap into the work. They are furnished in several sizes for U.S.S. taps.

Morse Twist Drill & Machine Co. Forged Drills

The Morse Twist Drill & Machine Co., New Bedford, Mass., has added to its line of twist drills a forged type.

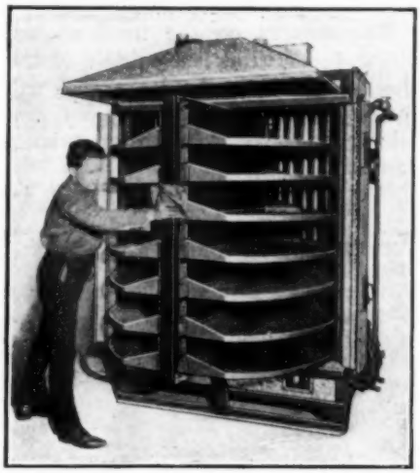
The forged drills are made in sizes ranging from $\frac{1}{4}$ to 2 in. inclusive and vary in $\frac{1}{16}$-in. steps. Their taper shank sizes are larger than those for the milled type. The shanks used on the forged drilled range from the No. 2 to the No. 5. The over-all lengths of these drills are also greater, in general. The company is prepared to furnish either the forged or milled type.

Shop Equipment News

Skinner Revolving-Door Oven

The revolving-door oven illustrated is made by the Skinner Bros. Manufacturing Co., Elizabeth, N. J. The oven is built for operation in connection with gas, electricity, oil and steam heating units for baking temperatures up to 650 deg. F. and is intended for japan, enamel or core baking and for drying.

The company claims a great reduction in fuel consumption in that while loading and unloading the



Skinner Revolving-Door Oven

shelves a temperature drop is not taking place within the oven. When a rack has been filled with loaded grids, the door is swung on pivots and the finished side is exposed for unloading. The length of time for the temperature to drop is limited to the time necessary to swing the door.

The heat is applied by the indirect method, and articles being baked are not exposed to the products of combustion. This method permits the baking of light-colored paints or enamels as well as the darker japan shades.

The oven is constructed of sheet-metal panels between which is 2 in. of insulation. Steel angles and corners are used for reinforcement, and asbestos insulation is inserted at points where heat losses are likely to occur from direct conduction. The shell of the oven is supported in a riveted and welded frame, which also supports the weight of the door.

The door is insulated and pivots in ball bearings. It is sealed to the oven front by means of angular corner members and flexible wipers along the top and bottom edges. It is locked by means of four swinging latches that engage with wedges on the door.

Ventilation is secured by means of an exhauster that draws the air through pipes in the combustion chamber where it is preheated before entering the baking chamber.

The equipment furnished for the unit includes an indicating thermometer, fourteen grid-supporting racks, the ventilation system and motor, and atmospheric burners. Additions to the equipment listed can be had as extras.

Winterhoff Saw and Arbor Universal, No. 1

The No. 1 universal saw and arbor, illustrated, is manufactured by the Winterhoff Tool & Machine Co., Elkhart Ave. & Jackson St., Elkhart, Ind. The machine is intended for bench use and is driven from a ½-hp., 1,750-r.p.m. motor at 3,400 revolutions per minute.

The table measures 10x12 in., and it can be raised and lowered, or tilted, as desired. A milled groove is provided for the protractor cutoff or ripping guides.

Winterhoff Saw and Arbor, Universal, No. 1

A 6-in. saw, an 8-in. metal disk sander or a 6x½-in. tool grinding wheel can be mounted on the arbor. The equipment includes, also, a wheel guard, a tool rest and a taper-cone internal sanding tool. The machine can be furnished as a plain saw without attachments.

Bullard Pressure Lubrication

The Bullard Machine Tool Co., Bridgeport, Conn., is equipping its products, including the mult-au-matics, contin-u-matics and vertical

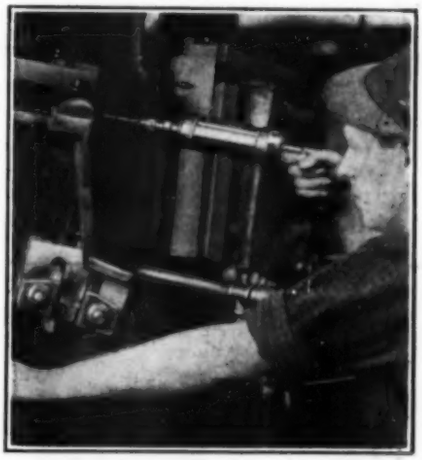


Fig. 1—Grease gun in use on Bullard Mult-au-matic

turret lathes for lubrication by the grease gun or pressure system at various points on external units.

In Fig. 1 is shown the method of applying the Zerk grease gun to the fittings, and in Fig. 2 can be seen some of the fittings at various points

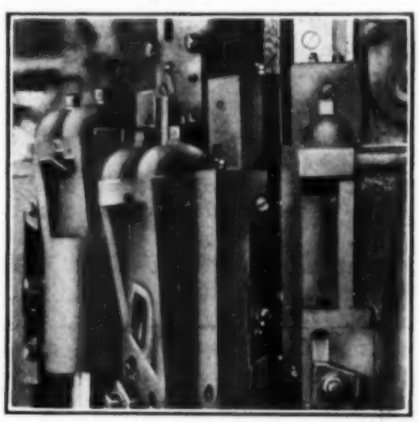


Fig. 2—Location of fittings for grease gun

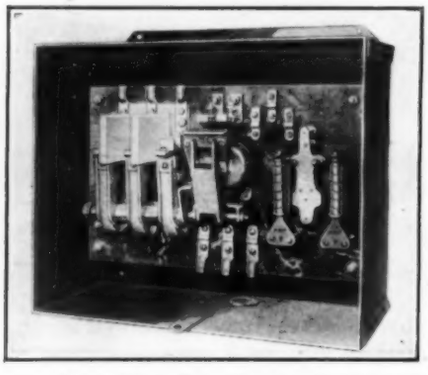
where oil holes were formerly provided. The pressure system has been adopted to overcome the problems that arose at these points where the accumulation of dirt and chips tended to clog the oil holes. In the system adopted the lubrication works from the inside out.

Shop Equipment News

Monitor Thermoload Starter

The thermaload starter illustrated is manufactured by the Monitor Controller Co., Baltimore, Md., for use with any type of drive where single-phase or polyphase motors are connected across the line. The starters give low voltage and overload protection, and also protection from damage due to phase failure. They will permit full-load, full-torque starting.

Two types of the starters are being manufactured. One has a self-resisting thermal relay and is used



Monitor Thermaload Starter

with three-wire, momentary-contact control circuits. The second type has the relay arranged for manual reset and can be used either with two-wire maintained-contract or with three-wire momentary-contact pilot-circuit controls. The three-wire momentary-contact master stations have the start circuit normally open and the stop circuit normally closed.

The thermal expansion units are of metal, no liquid being employed in normal installations. They are helically wound, fixed at one end and pivoted, but free to turn at the other end. The actuating arms attached to the free ends of the expansion units transmit their motion to the contact arm of the relay. Movement of this arm under overload conditions opens the relay and breaks the circuit for the holding magnet of the main-line contactor. This causes the contactor to open and disconnects the motor from the line. The arrangement is designed to prevent fluttering while the starter is in use.

The thermal or heating units of various ratings are interchangeable, enabling a starter to be transferred from one horsepower rating to another. This permits shifting or substituting of different motors without disturbing the wiring.

Noble & Westbrook Level-Graduating Machine

A special machine has been designed by the Noble & Westbrook Manufacturing Co., 19 Asylum St., Hartford, Conn., for marking the graduations and figures along the edge of a level. The machine is similar in principles of constructions and operation to the model described on page 914, Vol. 50, of the *American Machinist*.

The model which is illustrated, graduates the face and marks the numbers, in the same operation, on a two-foot aluminum level. The special table is moved by means of a handle through a rack and pinion arrangement. The circular die under which the work is pressed is 12 in. in circumference and it passes over the work twice. The rack and pinion arrangement insures the accuracy of the marking.

Pressure of the die on the work is secured by a spring through the cam

Noble & Westbrook Level-Graduating Machine

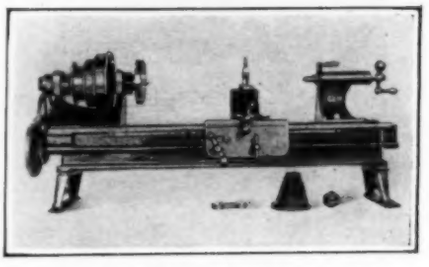
in the head of the machine. The pressure is released by pressing the treadle. When the pressure is released, the work can be inserted in the gages and then it can be reapplied.

Kiddle's "Gem Junior" Bench Lathe

The "Gem Junior" bench lathe has been brought out by Kiddle's Machine Tool Works, Kinsman, Ohio. The illustration shows the lathe with the cover over the gears removed. Screw cutting and general lathe work within its range can be done on this tool which follows the general principles of design and construction of the larger "Gem" lathe manufactured by this company and previously described on page 129, Vol. 47 of the *American Machinist*.

The centers on the machine are offset 1¼ in. from the middle of the machine so that the lathe tool will overhang the bed as little as possible and give a greater cutting capacity.

Work 20 in. in length can be



Kiddle's "Gem Junior" Bench Lathe

placed between the centers and in an emergency, the tailstock can be moved to overhang the bed enough to allow 3 in. additional capacity. The machine will swing work over the bed up to 10¼ in. in diam. Work 8¾ in. in diam. can be swung over the saddle.

The spindle is made from high-carbon steel and has a hole ⅝ in. in diam. through its length. The spindle bearings are 1¼x2¾ in. and are made from white bronze. Provision has been made to take up the wear of the spindle as well as the end play. No. 6 B. & S. centers are used.

The machine can be provided either with motor drive or with its drive from a friction countershaft. In the latter case, there are cone pulleys of three sizes, 6⅛, 5½ and 4 in. in diam. A 1¼-in. belt is to be used.

The size of the lathe is 9x36 inches.

News of the Week

Increased Efficiency of Management and Machinery Made Industrial Gains Possible in Year Just Passed

High wage level greatest accomplishment of the year

More efficient production, due to increased efficiency of management and increased use of mechanical power in industry, is largely responsible for such industrial gains as have recently been made, and will be a fundamental factor in our future progress, states a report issued last week by Magnus W. Alexander, president of the National Industrial Conference Board. Mr. Alexander's statement, analyzing industrial conditions at the close of 1925, and economic factors likely to play a dominant part in the immediate future, reads in part as follows:

"Perhaps the most significant, although not generally recognized factor in the achievement of such prosperity as the year 1925 has brought us, has been the accomplishment of industry in maintaining a relatively high wage level concurrent with low production costs, resulting in high domestic consumption power.

"Total production toward the close of 1925 was 42 per cent greater than it had been at the low point of 1924, although only 16 per cent more workers were needed to accomplish this result. Their average "real" weekly earnings are about 25 per cent greater than they were before the war, and about 7 per cent higher than at the peak of high wages in 1920.

Reduced Production Costs

"Improved industrial organization and administration, and the steadily increasing use of mechanical power are primarily responsible for the lowering of production costs; and reduced cost per unit of production has made it possible to maintain the existing high wage level without increasing prices and in some cases even permitting price reductions.

"It is the proper recognition of this fundamental relationship between high wages, low production costs and domestic consuming power, and the application of the principle involved, that largely determine the degree of our future prosperity. It will be a vital factor in continuing our economic progress, even in the face of increasingly keen foreign competition, while maintaining our existing, or even higher, standards of living.

"Europe is emerging from the chaos of post-war conditions, and her affairs are being stabilized. Greater economic stability will also be the keynote of our national economy in the immediate decades ahead of us, if, and to the extent that, labor is generally employed and content. Restricted immigration, steadying the rate of population increase, is tending to stabilize our labor supply. Constructive efforts on part of many employers are further helping to stabilize employment. Lessened sensonal and cyclical fluctuations and a fair wage will make for a more prosperous and generally content wage earning population.

"As yet, really only a beginning has been made in the direction of mechanizing industrial processes, a field affording immense investment opportunities. The few individual industries which for one reason or another have been lagging behind since the war, may also accomplish much by profiting from the example of others in lowering production costs through increased use of power, greater mechanization and improved administration."

Our Productive Capacity Doubled in 35 Years

On December 28 to 31 the American Economic Association, the American Statistical Association, the American Farm Economic Association, the American Association for Labor Legislation, the American Association of University Instructors in Accounting, the American Sociological Society and the American Political Science Association held meetings in New York, beginning with one joint meeting of the economic, statistical and labor legislation associations, followed by sectional meetings of the different associations. The three papers at the joint session were "The Best Measure of Real Wages," by Alvin H. Hansen, University of Minneapolis; "The Economic Significance of Changes in Real Wages," by Paul H. Douglas, University of Chicago; and "Real Wages and the Control of Industry," by Alvin Johnson, of the New School of Social Research.

Many interesting points were brought out, among them that wholesale food prices were not a good indicator of living costs owing to the wide variation in spread between wholesale and retail prices, and that average wages per hour were not reliable owing to overtime, bonus and unemployment. It was stated, however, that real wages have risen 27 per cent in 35 years and that productivity per man has increased 52 per cent in the same period. Clerical labor has lost 3 per cent in real wages while teachers have gained 100 per cent. The size of families has decreased from 4.9 to 4.3 per cent per wage earner.

The minimum or living wage seems to have become a fixture in spite of the law of supply and demand, and it was agreed that any industry that cannot pay the acknowledged living wage should go out of business. Mr. Douglas pointed out that wages in non-unionized industries had risen almost as much as in those that were organized, to which Mr. Loule replied that the fear of organization had its effect, and Prof. McCabe of Princeton said that much of the increase in real wages was due to the growing bargaining power of organized workers.

Elimination of Waste

A session on "Industrial Waste and Social Welfare" was presided over by Percy S. Straus, vice-president of R. H. Macy & Co., and papers were presented on "The Coal Problem," "The Channels of Waste," and "The Engineer's Viewpoint," by W. H. Hamilton, Stuart Chase and L. P. Alford, respectively. All were good, the most helpful being the figures presented by Mr. Alford on the work of waste elimination as a result of the Hoover engineering council. One of the results of the simplification and standardization work has been the saving of over $3,000,000,000 to industry in the past five years.

Other sessions dealt with unemployment, accidents and labor legislation.

Engineering Council to Aid Polish Students

The American Engineering Council, through its thirty national and local societies, has outlined a plan to aid Polish engineering students who seek training in the industries and universities of this country. The administrative board of the council, L. W. Wallace announced last week, has sanctioned a working arrangement with the council of the Institute for Scientific Management of Poland.

Comprehensive rules will govern the plan of co-operation, adopted after consultation with the Polish Legation in Washington. The institute must certify to the fitness of each student, for whom a complete schedule of study, including the designation of a sponsor in this country, must be worked out in advance. No deviation from this schedule will be permitted except "under extraordinary circumstances." No financial obligation is to be undertaken by the American Engineering Council.

January an Active Month for S. A. E. Members

Edward S. Jordan, whose style in phraseology and ability to put appealing human interest into motor car advertising have struck a popular chord throughout the country, is to be the speaker of the evening at the annual dinner of the Society of Automotive Engineers, which is to be held at the Hotel Astor, New York, Thursday evening, Jan. 14, during automobile show week. The subject of his address has not been announced but it is fully expected that he will present much food for mental digestion by the 1,000 engineering members who will attend the dinner.

C. F. Kettering, head of the research division of the General Motors Corporation, and past president of the society, is to be the toastmaster, and there will be short talks by Harry L. Horning, of Waukesha, Wis., the present president, and Thomas J. Litle, Jr., of the Lincoln division of the Ford Motor Co., who is the nominee for president of the S. A. E. for 1926. It is therefore assured that there will be a generous intermingling of humor with serious comment upon up-to-the-minute automobile engineering developments and problems.

The speeches, instrumental music and songs are to be put on the air by the Radio Corporation of America through Station WJY on a 405-meter wave length, beginning at 9:15 p.m. Eastern standard time.

So many developments and improvements are under way in the automotive field that four days are to be devoted to the presentation of addresses on them at the 1926 annual winter meeting of the Society of Automotive Engineers to be held in the General Motors Building, Detroit, beginning Jan. 26. There are to be three technical sessions each day and a dance carnival the night of Jan. 27 to afford the engineering minds a chance to return refreshed to consideration of technical problems in the forenoon of the third day.

Motion pictures, lantern slides, and the display and demonstration of devices and instruments will make each subject dealt with more clear and interesting. Among the motion pictures to be shown are scenes taken on the Amundsen polar flight last summer, and others showing the processes in automobile body production.

It is indicative of coming automotive improvements and the wide range of subjects now being studied by automotive engineers that separate sessions of the meeting are to be devoted to headlighting, vapor or steam cooling, fuels, superchargers, engines, brakes, body finishing, aircraft, motorcoaches and research work. There will be two addresses at each session, followed by discussion of the subject.

Buildings Will Be Ready for Sesqui-Centennial

Completion of buildings with an aggregate of 1,250,000 sq.ft. of floor space by June 1 to house exhibits at the Philadelphia Sesqui-Centennial, has been guaranteed by the managers of the exhibition. Assurances to that effect were given last week to the Secretary of State and the Secretary of Commerce by Mayor Kendrick and a delegation from Philadelphia. Everything will be in readiness for the opening on June 1, it was declared.

The President expects to announce promptly the names of the National Advisory Committee which will be the agency through which the co-operation of the federal government will be extended.

New President for Brooklyn Polytechnic

An event of interest to engineers will take place on the evening of Jan. 13, 1926, in the Opera House of the Academy of Music, Brooklyn, New York, when Dr. Parke Rexford Kolbe will be installed as the new president of the Polytechnic Institute.

Dr. Charles Alexander Richmond, president of Union College will give the principal address of the evening. The presentation of the charter, seal and keys will be made by Charles E. Potts of the class of 1892. President Kolbe will follow with his inaugural address. Other speakers will be Dr. William H. Nichols, chairman of the board of the General Chemical Co. and for many years chairman of the corporation of the Polytechnic; Dr. George S. Collins, senior member of the faculty, and Bancroft Gherardi, chief engineer of the American Telephone and Telegraph Co.

Official delegates representing the colleges, universities and societies have been invited to attend and acceptances indicate a noteworthy gathering of prominent men.

The Polytechnic Institute of Brooklyn is one of the oldest colleges of Engineering in the country, having been established in 1854. It grants the degrees of civil, electrical, mechanical and chemical engineer, as well as B. S. and M. S. in chemistry. President Kolbe comes to the Polytechnic Institute from the municipal University of Akron where he served as president for a period of twelve years.

Japanese Guarantee Machinery

To overcome any fears which may be entertained by prospective buyers of Japanese built electrical machinery of intricate construction, some makers in that country are offering an ironclad guarantee which is proving an effective argument with many buyers, says consular advises to the Department of Commerce.

To cite an instance, the Kinugawa Hydro-electric Co., recently placed an order for an 8,000 kw. turbo-engine, to be installed in its projected steam power plant in Senju, Tokyo suburb. The machinery is practically the first of the kind and size to be constructed in that country, but Mitsubishi engineers and the officials of the Mitsubishi Shipyards and Mitsubishi Electric Co. were so confident of their ability to turn out first-class goods that the guarantee in which the maker practically absorbs all risks that may accompany any faulty performance of the machinery was given to the buyer.

Congress to Investigate Essential Commodities

Passage of the Tilson resolution, providing for a congressional investigation of essential commodities under foreign control, means that this inquiry will go forward at once.

While greatest public interest will center on rubber and coffee, the investigation of tin, potash, nitrates, quicksilver and iodine will be conducted just as thoroughly.

While such control as has been exercised over the mineral commodities has not resulted in price advances in any way comparable to those that have taken place in rubber, the feeling on Capitol Hill is that the evil will grow rapidly if no effort is made to check it.

In the case of tin, no satisfactory substitute has been found for the entire tin content of solder. A portion of the tin can be replaced by cadmium, but any such change of practice frequently adds to cost. Tin plate has no substitute when used for most canning purposes. Facts along such lines as these will be developed by the subcommittee if present plans go through.

Much of interest is expected to come out of the inquiry into the quicksilver situation. The interest in that part of the study will be confined largely to the principle involved, as mercury is regarded as passing out of the essential classification. It is estimated that 1,000 flasks per year are necessary for the recovery of gold. This situation would change decidedly, however, if the use of mercury in boilers were shown to make possible material reductions in the cost of power.

In the case of chrome ore, it is the understanding that the monopoly is broken, but even then there is only one company standing between American consumers and the possible arbitrary action of those in control of the bulk of the supply. Morever, chromite has particular importance just at this time, in that it will be used in much larger quantities if the new German process of adding it directly to steel proves practicable, it is claimed.

Intensive research is being done at this time in an effort to find a solder which will bind chromium plated surfaces. It is believed the problem will be solved, whereupon another large new use will have been created.

Increased Duty

Acting upon a report from the Tariff Commission, the President has issued a proclamation increasing the tariff duty on taximeters from the rate of $3 each and 45 per cent ad valorem, named in the 1922 tariff act, to $3 each and 27.1 per cent ad valorem, based upon American selling price. Although the ad valorem figure is smaller than that named in the act, the transfer of the assessment from foreign value to American selling price increases the effective duty more than 50 per cent, this method being adopted because the investigations of the commission showed that 50 per cent would not equalize the differences in costs of production here and in Germany, the principal competing country.

Major Engineering Bodies Aid National Museum

In accordance with an invitation extended by the National Museum of Engineering and Industry to several societies to nominate representatives to its board of trustees, the four national engineering societies have responded favorably and are now represenated on the board which is constituted as follows:

Samuel Insull, chairman; L. P. Alford, B. C. Batcheller, Nicholas F. Brady, F. H. Colvin, Norman Dodge, Gano Dunn, Col. A. S. Dwight, Thomas Ewing, John R. Freeman, Col. Michael Friedsam, Major H. A. Gillis, Henry Goldmark, Frederick A. Halsey, Prof. Dugald C. Jackson, Luis Jackson, F. B. Jewett, John W. Lieb, Fred R. Low, W. W. Macon, L. C. Marburg, H. P. Merriam, M. I. Pupin, W. L. Saunders, J. Waldo Smith, Elmer A. Sperry.

Many of the members have donated to the museum original historical documents, old patent records, books, drawings, prints, models, photographs and descriptions of important work. Correspondence regarding such things is solicited.

In this connection the secretary says that he has, for some years, been collecting reminiscences of eminent men regarding some of their accomplishments which have not been previously recorded. There are undoubtedly many still living, or there may be some who have worked in co-operation with or in the service of others, who have accomplished notable work; and others who have had interesting associations with men of notable achievements. All of these could supply very interesting reminiscences if given the opportunity.

The secretary would like to hear by letter from any one recounting items of historical value or interest, or if they should happen to be in the neighborhood he would welcome a call during which their experiences can be recorded. All of these accounts will be carefully cataloged and placed in the research files for reference by any one who can make proper use of them. They will eventually go for permanent preservation to the museum which will be part of the Smithsonian Institution at Washington.

The secretary may be addressed as follows: H. F. J. Porter, secretary, National Museum of Engineering and Industry, 29 West 39th St., New York City.

U. S. Chamber Issues Cost Standards

The Department of Manufacture of the Chamber of Commerce of the United States has just issued a pamphlet dealing with the subject of cost accounting through the use of standards.

Actual experiences of manufacturers who have employed standard cost systems, and a general description of the various methods used are contained in the pamphlet.

As explained in the pamphlet, "a standard cost system is one which employs predetermined figures in the accounting in place of actual costs of products. In a standard cost system the sum total of the standard costs of goods produced is compared with the total outlay in money during the period of such production. The procedure is the reverse of that employed in the job cost system. In the latter the actual costs are allotted to the individual products or lots. In a standard cost system cost values are assigned to the products and the total of such assigned values compared with actual outlay of production.

The pamphlet states that cost accounting through the use of standards is gaining in favor with executives and accountants. During the past few years, numerous cost systems employing standards or predetermined cost figures have been devised and put to satisfactory use, but generally, there is no uniformity of practice under the method.

Copies of the pamphlet can be obtained by applying to the Department of Manufacture, Chamber of Commerce of the United States, Washington, D. C.

Railroads Find Use for Old Materials

In line with their general policy of bringing about greater efficiency and economy in operation, which has already made possible a marked reduction in freight charges to the public, the railroads of this country are realizing substantial savings through the reclamation of old material, according to a survey just completed by the Purchases and Stores Division of the American Railway Association.

While every road in the country has made provision for reclamation of such materials, the savings vary, being contingent on the size of the road, its location with reference to the markets and the extent to which this work is carried on.

As indicative of the extent to which this work is being conducted, old metallic roofing and empty powder or carbide cans are converted into tin buckets, cups and other tin ware, while old broom handles and other mill offal are made into staffs for signal flags such as are used extensively by the railroads. Scrap locomotive tire steel is being converted into hammers while even old hose is being used for the manufacture of baggage mats. Canvas, which has reached the end of its usefulness for the purpose for which it was originally bought, is sent to the upholstering shops of the various railroads and there worked over into aprons for workmen, locomotive steam pipe covering and for other purposes. Broken leaves from springs are made by the reclamation departments into elliptic springs, while flues which can no longer be used in locomotive boilers are flattened and made into washers. Bolts are straightened and rethreaded, old timber cut into planks for crossings and other purposes, second-hand rail is made into guard rails, car wheels which have become flat are made usuable again by grinding, while oily, dirty waste taken from journal boxes is cleaned and re-oiled and again used.

Heald Machine Company Celebrates Centenary

The Heald Machine Co., of Worcester, Mass., on Thursday, Jan. 7, celebrated the one-hundredth anniversary of its founding by Stephen Heald in the little Massachusetts town of Barre. On this date in the year 1826 Mr. Heald opened his little machine shop, located beside a branch of the Ware river from which it derived power to turn its wheels, and announced to his neighbors that he was ready to undertake machine jobbing of all kinds.

The conditions under which a machine shop was conducted a hundred years ago were quite different than they are today. The village machinist of that time was generally a farmer, at least in a small way; was certain to be a skilled blacksmith; and probably combined the craft of cabinet-making, the forerunner of pattern-making, with his other accomplishments. Mr. Heald was all of these, and the old ledger with which Stephen began business, now in possession of the Heald Co., informs us that besides "turning one axle for grindstone" and other strictly machine shop jobs, he not only forged parts for plows and other farm implements but also made kitchen chairs and similar articles of furniture.

On the other side of the ledger, too, the entries indicate a state of affairs not strictly in accordance with modern notions of business methods, for the quaint handwriting naïvely informs us that Mr. Heald once accepted "1 pr. pantaloons and 3 maple logs" in lieu of coin of the realm in adjudication of a business transaction.

Added a Foundry

Because of the limited employment of machinery for other than agricultural and woodworking purposes, as well as of the difficulty of obtaining iron castings, it is not strange that Mr. Heald should drift into manufacture of these lines of machinery, which were made largely of wood and forged iron. It was not until the early "fifties" that a foundry has added to the business.

The first strictly machine shop appliance to be manufactured in quantities was the American drill grinder, for which a market was found in all parts of the world. From this simple machine the successors of Stephen Heald became more and more interested in grinding machinery, and the rapid development of the abrasive processes in the latter part of the century led to the abandonment of all other lines and to the concentration upon grinding machinery, which is now the sole product of the company.

The plant increased rapidly in size and importance, and in 1903 was moved to its present location in the city of Worcester.

An attractive booklet, the covers of which are made in fac-simile of the old ledger above mentioned, describes briefly the founding and growth of the company from the one-man shop of 1826 to the large and fully equipped modern factory of the present day. This book is being sent to all customers and friends of the Heald Machine Company.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

(Copyrighted, Theodore H. Price Publishing Corporation, 16 Exchange Place, New York)

IN REVIEWING the business history of the United States for the year just ended the supply of superlatives has been almost exhausted.

The Christmas trade has been the biggest on record. Railroad earnings and bank clearings have been the largest ever and all the customary indicia of business reflect the remarkable prosperity that this country has enjoyed. This prosperity seems to be spreading to Great Britain and continental Europe, for the English papers are becoming optimistic and a great improvement in business is reported from France and Germany, as well as from Russia, where the capitalistic regime is being gradually readopted.

Even after making due allowance for the seasonal cheerfulness that Christmas induces there seems to be no doubt that the world is rapidly recovering the arrears of production and consumption for which the war is responsible, and in so far as economic conditions are concerned it is quite possible that 1930 will find society about where it would have been if there had been no war.

Of course, such a recovery means abnormal activity while it is in progress, and the problem is to determine how long the abnormal will last. There are two ways in which it may be ended. The financial and physical machinery by which business is handled may be overtaxed and break down or prices and wages may rise to levels that will check consumption.

As yet neither of these possible eventualities is in sight, but the ease with which many basic commodities have been recently advanced suggests circumspection. Thus wheat has had a meteoric rise. Cotton has jumped up sharply in the face of the largest world crop on record, and jute is higher than for years.

Coffee is also dearer on the belief that Brazil or Sao Paulo will be able to make a loan in London, and sugar is again moving upward, but with characteristic deliberation.

On the New York Stock Exchange a buoyant tone continues to prevail, and in that market the year ended in what is described as a blaze of glory.

On the "Curb" similar conditions obtained, as well as in what is called the "over the counter" market where bank stocks in particular were strong upon unconfirmed reports that the Chase National Bank, the Mechanics and Metals Bank, the Chemical National Bank, the National Park Bank, the Chatham and Phenix Bank and the Central Union Trust Co. were to be resolved into one huge institution that would have over $1,320,000,000 in resources and more than $1,000,000,000 in deposits.

Each of the banks mentioned has denied participation in the proposed consolidation, but a belief that something of the kind is pending persists and has helped to inflame the speculative imagination.

Then there are the many industrial consolidations that are reported from day to day.

It is as true as ever that the whole cannot exceed the sum of all its parts, but "combination" has always been a word to conjure with in times like the present and the mere suggestion of a merger will now add from five to ten points or more to the market value of the stocks affected.

Of course, there will come a time when the money needed to finance all these schemes will be difficult to get, but there is no scarcity of credit yet, although the Federal Reserve statement shows a seasonal decline in the reserve ratio that will probably be recovered when the money that Christmas put into circulation gets back into the banks.

If such a return movement is not well under way by Feb. 1 it will be wise to shorten sail, for in the natural course of events the reserve ratio of the banks should give the first signal of over-expansion.

The political trend is another phase of the situation that should be carefully watched. The Western farmers and their representatives in Washington are demanding that some way to guarantee them a satisfactory price for the very necessary products they provide should be found.

Failing this they threaten to insist upon a reduction of the tariff, and since tariff wars have never helped American business it is quite possible that the present activity in business may be checked by the activities of the farm "Bloc" in Congress.

The widespread overbuilding to which so many experts have recently called attention, the congestion in Florida from whence thousands are now returning because food and lodging are not to be had there, and the international rumpus that Mr. Hoover has raised over the price of rubber are other foci of possible irritation that should be watched.

But none of the possibilities mentioned seems to be presently imminent, and "full speed ahead" is the signal that most commercial and industrial captains are giving to their engineers as the ship of American business sails forth with confidence upon the high seas of 1926.

The barometer stands at Fair, the trade winds are favorable, the sails are all set, they appear to be drawing well and while occasional gales are to be expected there is no reason why they should not be weathered with ordinary care and alertness.

What's Doing in Industry

The first week of the new year brought no special activity in machine tool markets. Business ran along just as it had been going for the past few weeks, new inquiries being the most important feature of a market quite satisfactory to most dealers and manufacturers.

Sales that had been held up pending new appropriations and inventory taking are already beginning to materialize, and automobile manufacturers in Detroit are inquiring for machines to equip new plants designed to bring production of motor cars up to the expected consumption of 1926. Several million dollars will be spent in Michigan for such expansions. Cincinnati reports more orders and inquiries than last year, with the market quite satisfactory. Chicago reports that present inquiries indicate a good business for the next three months.

In Milwaukee production of machine tool and machinery plants reached its maximum in December, with orders coming at a good rate. The New York market continues active, December totals having been much better than were anticipated.

Latest figures of the Department of Commerce show that exports of metal-working machine tools in November were almost a half million dollars more in value than in the same month last year, and one hundred thousand dollars more in value than in October of this year. Lathes, milling machines and screw machinery were the leaders.

The general business barometer stands at Fair, and while occasional gales are to be expected, there is no reason why they should not be weathered with ordinary care and alertness.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

Chicago

The closing days of 1925 find the Chicago machine tool business in a condition that may be described as generally satisfactory. Due to the holidays, and to inventory taking, little actual trading is being done this week, but inquiries are numerous, and come from many different lines of industry, not only in the Middle-West, but in the East. If developments turn out as confidently expected by men long identified with machinery interests. January, 1926, will witness an exceptionally active market.

Practically all orders recently taken are for January delivery, and most of the inquiries received have reference to the placing of contracts to be closed during the first three months of 1926. Comparing the business of December this year with that of the same month last year, dealers say that, if anything, there is a shade of difference in favor of 1925.

The Edgewater Steel Co. of Pittsburgh is in the market for the following used machinery: one armor plate shear; one motor-driven power press of 400-ton capacity; two hydraulic presses of 400- and 300-ton capacity respectively, and one hydraulic shear. The International Harvester Co. of Chicago, the Yellow Truck and Coach Co. of Chicago, and the Illinois Central Railroad Co. are mentioned as soon to be in the market for machine tools.

Milwaukee

Production of machine tools in the Milwaukee district during December reached probably the highest point in more than a year's time, and in some shops exceeded any month since the spring of 1923. This was accomplished to a large extent by a reduction of the usual holiday recess to two three-day periods, which was made necessary by the unusual pressure which buyers are exerting to get delivery with the least possible delay. Sales for December were moderate, and of sufficient volume to fully compensate for the quantity shipped out.

The tool industry, as a whole, enters the new year with the largest volume of business on its books in about two years, and several shops report that they would be able to operate at present schedules for three to four months if no new business was available in the meantime. The situation is generally considered as eminently satisfactory, while the outlook appears to be equally as promising. There have been no earmarks of a boom, but the recovery has been steady and regular.

The automobile industry has been buying with relative freedom once more, having just passed its inventory period, and prospects are for a continuance of active demand for several months to come. While advantage was taken of the inventory period to make installations of much of the new equipment purchased during the past three to five months, not all of the requirements for 1926 have been met, judging by the character of inquiries.

The agricultural equipment industry presents one of the most glowing prospects for the metal-working equipment industry at the turn of the year. The railroads, which have purchased on a scale below expectations during the past year or two, are counted upon to furnish considerable new tool business as their situation improves.

Cincinnati

While several Cincinnati machine tool manufacturers report a considerable amount of activity in the past week, the general statement is that the usual first-of-the-year dullness prevailed. However, it is explained that there were more orders and inquiries received than during the same period of the previous year, and the situation is regarded both as satisfactory and as encouraging.

The bulk of the week's business was made up of orders that came from all parts of the country, these being well diversified as to sizes and types of tools, most of which were for replacement. A few export orders were received, including one of fair size from South America.

Selling agents report that their bookings in the past week were larger than in the corresponding period of the previous year. The feeling is that after the stock-taking season is over and when inventories have been completed, the volume of orders coming in will show a material increase.

Inquiries received in the past few days are said to show that there is an increased tendency toward expansion on the part of users of machine tools in various lines, and this is expected to be reflected in the sales of the next few weeks.

The general feeling expressed by manufacturers and selling agents is that the business trend will continue to be upward for at least several months, and perhaps for the entire year. All are proceeding with caution, however, and there is no tendency toward over-production.

Detroit

While automobile manufacturers are entering into the New Year with a greater degree of caution than has accompanied their movements during the past few months, there is no noticeable let-down in activity in the machinery and machine tool field.

As a whole, market conditions are good. There is ground for the belief that the first quarter of the year will be better than the corresponding period in 1925. Many replacements of worn-out machines must be made, and although the year may not be productive of any large orders, the demand for small tools and automatic machines which serve more than one purpose will presumably be large.

In anticipation of continued record business in 1926 automobile plants in the Detroit district are investing sums aggregating more than $25,000,000 in new factory buildings, machinery and general equipment. The chief building and expansion projects under way now may be itemized thus:

The Cadillac Motor Car Co. will expend $3,000,000 for new administration and assembly buildings which will allow rearrangement of factory layout and more space for machinery to increase output.

The Buick Motor Co. is spending $2,000,000 on buildings and machine tool equipment to make daily volume of 1,200 cars a day possible.

Dodge Brothers, Inc., has under way assembly, die-shop and forge plant extensions which will cost $8,000,000 and boost maximum output to 1,500 cars a day.

Willys-Overland is putting $2,000,000 into extra buildings and machinery with the aim of attaining a maximum of 1,350 cars daily.

The Olds Motor Works at Lansing has announced that factory capacity will be increased from the present 250 to between 400 and 500 cars daily.

The Fisher Body Corporation, in anticipation of the new Pontiac six-cylinder car to be coupled with the Oakland from the Oakland Motor Car Co. factory at Pontiac, is investing $2,000,000.

These are the major plans counted upon to increase volume this year. To this should be added unestimated amounts that are being spent by a multitude of accessory factories which supply motor cars makers with essential units.

Practically every one of them will be forced to increase both space and equipments for next year, which will run the expansion total much higher than $25,000,000.

New York

Business in this market continued at a most satisfactory rate during the closing days of December. Orders received by local dealers proved that many buyers had waited late to place orders for equipment. The usual holiday dullness was conspicuous by its absence and has fostered a decided spirit of optimism in the future.

Of particular notice in the week's transactions was the buying by railroads. Funds left from yearly appropriations were used to purchase tools that had been waiting sanction for several weeks. Some of the machines taken by these buyers in the past week were: A 90-in. driving wheel lathe, a 400-ton wheel press, a 48-in. car wheel borer, a 90-in. axle turning lathe, three 36-in. x 17-ft. lathes, a jig boring machine and an automatic centering machine.

The number of new inquiries received was not greater than in previous weeks, but there were several modifications and renewals in old estimates. It is expected that these changes will be followed by actual orders as soon as new funds are appropriated.

The second-hand market continues rather quiet, the apparent lack of good used machines making this business more or less uncertain.

Philadelphia

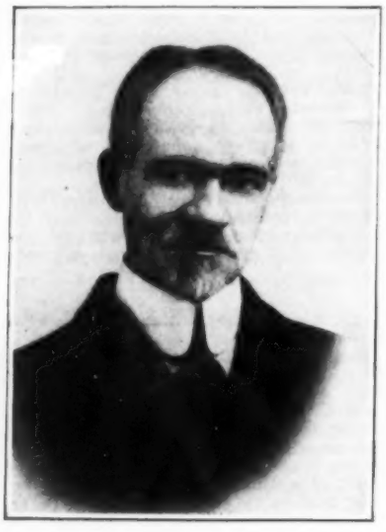
Manufacturers and dealers in machinery and machine tools in Philadelphia enter the New Year with a feeling of hopefulness for a prosperous period. Indications for an active year are brighter by far now than they were at the beginning of 1925, and with basic economic conditions continuing sound, the industrial sky appears to be clearer at this time than for some months.

Based upon orders already received and inquiries that have come in during the last two weeks, it was apparent to most of the dealers and manufacturers that the early months of the New Year will be busy. One of the large machine tool manufacturers announced that several large orders have been received in the last month, and that others are in process of being closed. Most of the orders and inquiries come from industrial establishments over a scattered area.

Henry M. Norris Dies Suddenly

Henry McCoy Norris, secretary of the Cincinnati-Bickford Tool Co., and one of the foremost mechanical engineers in the country, died suddenly at his home in Cincinnati on Dec. 24. He was 60 years old.

Mr. Norris was a native of New Jersey, lived at one time in Philadelphia, but spent the greater part of his business career in Cincinnati, where he resided for the past 35 years. He started his association with the machinery industry in the plant of Bement, Miles & Co., in Philadelphia, later going to the Ferracute Machine Co., at Bridgeton, N. J., as designer. He then became associated for short periods



Henry M. Norris

with the Brown & Sharpe Manufacturing Co., of Providence, the Pond Machine Tool Co., of Plainville, N. J., and in 1892 came to New York as chief inspector for the Garvin Machine Co. In the following year he went with the Appleton Manufacturing Co., in Philadelphia, as superintendent, and in the next few years was connected at different times with the Riehle Bros. Testing Machine Co., the Campbell & Zell Co., of Baltimore, and in 1897 want to the Bickford Drill and Tool Co., of Cincinnati, as general superintendent and works manager.

In 1909 when this company was merged with the Cincinnati Machine Tool Co., forming the Cincinnati-Bickford Tool Co., Mr. Norris was elected a director and also secretary of the organization.

Mr. Norris was very active in the affairs of several trade bodies and engineering societies. He was a pioneer member of the National Metal Trades Association, and a charter member of the Army Ordinance Association. He was a prominent member of the American Society of Mechanical Engineers and was manager of that body from 1920 to 1923. He was the author of more than one book on machine tool design, and contributed to many magazines and historical treatises.

As an inventor of machine tools Mr. Norris made several worthy contributions to the industry, among which were the first speed box used on a machine tool, the first high-speed lathe and a high-speed, high-power radial drill. In recognition of his abilities in this line he was selected as one of the eight efficiency engineers for service with the U. S. Ordinance Department. In 1918 he was appointed a member of the War Industries Board and rendered valuable assistance in assembling the country's machine power for the making of war materials.

What the Railroads Are Doing

Cars loaded with revenue freight continue to exceed all previous years, the total for the week of December 19 having been 967,886 cars, according to reports filed today by the carriers with the Car Service Division of the American Railway Association. This was an increase of 67,232 cars over the same week last year and 90,259 cars in excess of the same week in 1923. It also was a substantial increase over the corresponding weeks in 1920, 1921 and 1922.

The Interstate Commerce Commission has granted authority to the Illinois Central R.R. to issue $9,240,000 of equipment trust certificates to apply on the purchase of the following:

Five hundred 40-foot, 40-ton automobile box cars at $2,225 each; five hundred 40-foot, 40-ton automobile box cars at $2,227 each; two hundred 40-foot, 50-ton flat cars at $1,770 each; two hundred 40-foot, 40-ton double-deck stock cars at $1,990 each; one hundred and thirty suburban motor cars at $49,250 each; 85 suburban trailer cars at $25,660 each.

The earnings for 1925 of the New York Central's crack train, the Twentieth Century Limited, will exceed $10,000,000, a new high record for this train. This figure is gross and includes Pullman fares.

It is said that one-third of all travelers between New York and Chicago on all railroads are carried on the Century. It has been operated this year in nearly 2,000 sections.

The application of the Detroit & Ironton R.R. to acquire and operate the Detroit, Toledo & Ironton, and the Toledo-Detroit railroads has been assigned for hearing before Interstate Commerce Commission Examiners Boles and Molster at Washington on Jan. 18.

News of the Automotive Industry

Production of motor vehicles in 1925 reached a high record of 3,883,000 cars and 492,000 trucks, a total of 4,325,000, according to a statement issued last week by Charles Clifton, president of the National Automobile Chamber of Commerce. The highest previous year's production was in 1923, when 4,086,000 cars and trucks were produced.

The wholesale value of cars and trucks manufactured this year approximates three billion dollars. The year was particularly favorable for the motor truck industry, which turned out close to 500,000 vehicles, or nearly 12 per cent of the total output of the industry. The figures include the production of Canadian plants making cars of United States design.

A large part of the new record in production was credited to the expanding foreign market for American automobiles. The exports this year passed the 550,000 mark, as compared with 386,000 last year.

Glenn L. Martin, aircraft manufacturer of Cleveland, has announced that the United States Navy has awarded his company, which bears his name, a contract for the construction of 24 single-engine bombing planes, at a cost of $803,000. The contract was awarded several days ago.

The manufacturer also revealed that he designed a new bomber for the Navy and that he is drafting plans for a new Army bomber.

Export of Machine Tools Continues Upward

Exports of metal-working machinery for November, with revised comparative figures for November, 1924, as compiled by the Department of Commerce, are as follows:

	Nov., 1924 Value	Nov., 1925 Value
Lathes	$140,620	$317,297
Boring and drilling machines	31,218	22,921
Planers, shapers and slotters	34,381	39,076
Bending and power presses	44,672	40,530
Gear-cutting machines	74,728	56,949
Milling machines	57,937	164,138
Thread-cutting and screw machines	52,707	87,763
Punching and shearing machines	20,069	4,125
Power hammers	27,813	17,254
External grinding machines	55,381	112,149
Internal grinding machines	18,750	96,112
Other grinding and sharpening machinery	49,220	47,662
Chucks for machine tools	32,455	15,963
Reamers, cutters, drills, taps, dies and other metal-working tools	209,786	185,514
Pneumatic portable tools	74,661	85,432
Foundry and molding equipment	39,617	34,011
Other metal-working machinery and parts of	339,077	437,246
Metal-working machine tools (total)	$1,303,092	$1,764,147

Personals

S. D. HEED has been elected president of the board of the Hurley Machine Co., of Cicero, Ill.

PHILIP V. TIPPET has been appointed assistant chief engineer of the Farrel Foundry and Machine Co., Ansonia, Conn.

W. H. MUNRO has returned to Canada as sales manager of Canadian Vickers Ltd., Montreal.

EDWARD RIVETT, founder of the Rivett Lathe and Grinder Corporation, of Boston, celebrated his seventy-fifth birthday on Jan. 5.

GEORGE A. COLLEY, formerly associated with the Climax Engineering Co., of Clinton, Iowa, has joined the A. G. Griese Co., of New York.

W. W. NICHOLS has been appointed assistant to W. R. Brown, general manager of D. P. Brown & Co., manufacturers of belting, of Detroit, Mich.

GEORGE M. PEARSE, for many years Western representative for the Brown & Sharpe Manufacturing Co., of Providence, has been appointed sales manager of the Union Twist Drill Co., of Athol, Mass.

H. O. WILLIAMS has joined the Braeburn Alloy Steel Co., of Braeburn, Pa., as vice-president in charge of sales. He was formerly connected with the Bethlehem Steel Co.

ROBERT J. ANDERSON, consulting metallurgical engineer, has been appointed district manager of F. J. Ryan & Co., industrial heating engineers, of Philadelphia, Pa. Dr. Anderson will represent the company in Cleveland and in the Ohio district.

A. J. BRANDT has been appointed vice-president in charge of operations of the Oakland Motor Car. Co., of Pontiac, Mich. Brandt came to Oakland last April, and up to the present time has been works manager.

L. A. SCHMIDT, formerly chief engineer of the Fiat Co., at Poughkeepsie, N. Y., has been appointed consulting engineer and assistant to the general manager of the Locomobile Co., of America. He will have general direction of all engineering at the Locomobile plant. T. L. Cowles, who was formerly the assistant of D. G. Roos, will continue in the organization, working in conjunction with Mr. Schmidt. Mr. Roos, who was chief engineer of Locomobile, recently resigned to go with the Nordyke & Marmon Co., of Indianapolis.

JOHN C. BANNISTER, vice-president in charge of engineering of the Walworth Co., Boston, who decided several months ago to retire from active work on Jan. 1, was given a farewell dinner at the Harvard Club in Boston, on Dec. 21. There were present twenty-eight men, including the executive officers of the company and a number of Mr. Bannister's most intimate associates in the Boston offices.

The chief feature of interest was the presentation to Mr. Bannister of a handsome book containing letters from friends of Mr. Bannister all over the country. These letters made up a most striking acknowledgment of Mr. Bannister's contribution to the industry and to various other fields of activity.

F. H. MOREHEAD chief engineer of the company succeeds Mr. Bannister in active charge of engineering.

Business Items

The Burgess Battery Co., of Madison, Wis., has purchased the plant of the Stevens Motor Car Co. at Freeport, Ill.

The Link-Belt Co., of Chicago, announces the opening of a branch office in the First National Bank Bldg., Milwaukee, Wis. R. C. Kendall has been placed in charge.

The Fred T. Kern Co., of Milwaukee, manufacturer of mining machinery, has moved its plant from 774 Third St. to 650 Lawton Place.

The Aldrich Pump Co., of Allentown, Pa., has taken over the designs, patents and manufacture of Earle centrifugal pumps which have been manufactured by the Earle Gear and Machine Co., of Philadelphia.

A company has been formed at Vancouver, British Columbia, for the establishment of a Diesel engine manufacturing plant. Sydney Asser is president. Work on the first unit of the factory will commence immediately.

The National Iron and Wire Co. has purchased the plant of the E. W. Bliss Co. at St. Clair Ave. and 222nd St., Cleveland, Ohio. Work of transferring manufacturing activities into the new location has already been started.

The Huronia Steel Co. has been incorporated in Canada and has taken over the plants at Collingwood, Ontario, formerly operated by the Kennedy Co. and the Electro Castings Co. It is the intention of the new company to add considerable equipment, including an electric furnace, rolling mills and molding machines.

The Standard Steel Specialty Co. has been organized at Beaver Falls, Pa., to engage in the manufacture of machine keys, racks, steel sections and taper pins. Arrangements have been concluded with the Union Drawn Steel Co., whereby the new company has taken over the above business formerly conducted by the Standard Gauge Steel Co., which was owned by the Union company.

The Westinghouse Electric and Manufacturing Co. announces that its prime mover sales activities will hereafter be conducted by a new organization from the South Philadelphia Works. Howell Van Blarcom, assistant to the manager of the power department of the South Philadelphia Works, has been appointed manager of the new organization, and R. E. Carothers has been made his assistant.

Obituaries

C. E. TWITCHELL, chief pattern maker for the Warner & Swasey Co., of Cleveland, was killed in an automobile accident on Dec. 19.

G. W. HUDDLESTON, president of the Hamilton Foundry Co., Hamilton, Ontario, died at his home in Hamilton, Dec. 11, in his 68th year.

CHARLES L. NEDOMA, of the engineering department of the Cadillac Motor Car Co., was stricken while at the home of a friend in Detroit on Dec. 23 and died instantly. He was born in Prague, in 1877, was a graduate of the School of Engineering of the University of Prague and came to this country in 1910. His first connection in Detroit was with the Chalmers Motor Car Co., and he later became secretary of the Cadillac engineering department.

JOHN KIRBY, JR., for four years president of the National Association of Manufacturers, and one of the most prominent business men in the country, died at his home in Dayton, Ohio, on Dec. 29. He was 75 years old and had been in failing health for several years. Mr. Kirby was president of the Dayton Manufacturing Co., president of the Headlight Co., vice-president of the Mercantile Meal Milling Co., and a director of the Canadian Car and Foundry Co. He was an active member of the National Metal Trades Association and the National Industrial Conference Board.

HARRY A. LOZIER, JR., formerly president of the Lozier Motor Co., a resident of Westfield, Mass., died on Dec. 26 at Clearwater, Fla., following a brief illness. Mr. Lozier was 58 years old. He was associated with his father in the Lozier Manufacturing Co. For a number of years he was connected with the sales department, and represented the company abroad. The company first manufactured marine motors and was the forerunner of the Lozier Motor Co., which was moved to Detroit, Mich.

He at one time manufactured the H. A. L. automobile. At another time he represented the Chandler Motor Co. in northern New York.

Trade Catalogs

Pyrometers. Charles Engelhard, Inc., 30 Church St., New York, N. Y. Bulletin No. A1 is a description of the applications and of the construction of the type P-1 indicator. Bulletin 28 covers the type S recorder manufactured by this company, many illustrations being used to simplify the explanation of the details of the instrument. Samples of the indicator dials and the charts are included in the bulletin.

Pamphlets Received

First Aid to the Injured. Published by the Travelers Insurance Co., Hartford, Conn. This 22-page, 5¼x9¼-in. pamphlet contains the most generally accepted methods and practice where first-aid treatment is necessary.

The subjects are clearly and systematically arranged. A list of material recommended to be included in the first aid kit is given.

Calendar of Local Meetings

National Association of Cost Accountants

New York Chapter. Jan. 12. Income Tax.

Albany Chapter. Jan. 13. Cost Problems and Methods in the paper mill and the printing plant.

Worcester Chapter. Jan. 14. Standard Costs and Variances.

Mohawk Valley Chapter. Jan. 18. Burden Distribution.

Hartford Chapter. Jan. 19. Relation of Cost Accounts to Taxation.

Los Angeles Chapter. Jan. 19. Development of Cost Accounting.

Scranton Chapter. Jan. 19. Debatable Points in Cost Accounting.

Twin Cities Chapter. Jan. 19. Carrying Out the Budget Plan.

Syracuse Chapter. Jan. 20. Cost Analysis to Disclose Waste in Distribution.

Cleveland Chapter. Jan. 20. Inventory Methods.

Rochester Chapter. Jan. 20. Business Forecasting.

Chicago Chapter. Jan. 21. Planning for Reduced Production Costs.

Boston Chapter. Jan. 28. Accounting for Depreciation.

Buffalo Chapter. Jan. 28. Factory Overhead.

San Francisco Chapter. Jan. 28. Relation of Business Cycles to Costs and Prices.

Society of Automotive Engineers

Southern California Section. Jan. 8. "How to Determine Correct Carburetor Adjustment and Effects of Improper Adjustment on Economy, Power, Carbon, Engine Wear, and Crankcase Dilution," by J. F. Dixon and O. H. Ensign.

Washington Section. Jan. 8. "Motor Vehicle Headlighting," by Col. R. E. Carlson.

Metropolitan Section. Jan. 11. "What's New at the Show?"—Short discussion by engineers from each of the companies exhibiting cars at the National Automobile Show in New York City.

New York. Jan. 14. Annual dinner, Hotel Astor.

Buffalo Section. Jan. 19. "Opportunity in Transportation for the Automotive Engineer," by J. E. Schipper.

Dayton Section. Jan. 20. "Aerial Photography," by Lieut. George Goddard.

American Society for Steel Treating

Buffalo. Jan. 21 and 22. Winter sectional meeting, Hotel Statler.

Hartford. June. Spring sectional meeting.

American Society of Mechanical Engineers

New Haven. Jan. 12. Fuels for Domestic Heating.

Washington, D. C. Jan. 12. Super-Power. Joint meeting with A.I.E.E.

New York. Jan. 14. Welded Pressure Vessels.

New York. Jan. 18. Domestic Heating.

Meriden. Jan. 19. Manufacturing and Management Problems.

Forthcoming Meetings

American Society for Steel Treating. Winter sectional meeting, Hotel Statler, Buffalo, N. Y., Jan. 21 and 22. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

Society of Automotive Engineers. Annual meeting, General Motors Bldg., Detroit, Jan. 26 to 29. Coker F. Clarkson, secretary and general manager, 29 West 39th St., New York City.

National Foreign Trade Council. Thirteenth national foreign trade convention, Charleston, S. C., April 28, 29 and 30. O. K. Davis, secretary, India House, Hanover Square, New York.

American Gear Manufacturers' Association. Tenth annual meeting, Book-Cadillac Hotel, Detroit, May 13, 14 and 15. T. W. Owen, secretary, 2443 Prospect Ave., Cleveland, Ohio.

American Supply and Machinery Manufacturers' Association. Annual convention, Hotel Statler, St. Louis, week of May 17. F. D. Mitchell, secretary, 1819 Broadway, New York.

National Association of Purchasing Agents. Eleventh annual convention and exposition, Ambassador Hotel and Auditorium, Los Angeles, Calif., June 9 to 12. W. L. Chandler, secretary, Woolworth Bldg., New York.

American Society for Testing materials. Twenty-ninth annual meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, N. J., June 21 to 25. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia.

The Weekly Price Guide

Rise and Fall of the Market

Price of pig iron is practically the same as a month ago. Compared with Jan. 1, 1925 it is lower by about $1 per ton in the New York, Philadelphia and Pittsburgh districts. Birmingham, Cincinnati and Chicago markets are about $1.50 per ton above this time last year. Steel demand is more active in semi-finished material, bars, and strip steel, also for railway use and agricultural implement manufacture, than it is for construction and automotive use. The principal hot-rolled products are quoted as follows: bars, $2@$2.10 per 100 lb.; shapes, $1.90@$2; plates, $1.60@$2 per 100 lb., Pittsburgh mill. These prices are the same as a month ago. At this time last year bars were $2.10; shapes, $2.10; and plates, $2 per 100 lb. at mill.

(All prices as of Dec. 31)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.05
Northern Basic	24.27
Southern Ohio No. 2	24.27
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	28.37
BIRMINGHAM	
No. 2 Foundry	22.00@23.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	24.16
Virginia No. 2	29.17
Basic	23.16
CHICAGO	
No. 2 Foundry local	23.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	26.55
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	22.27
Basic	22.27
Bessemer	22.27

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.50
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.50	3.89	3.15	3.50
No. 12	2.55	3.94	3.20	3.55
No. 14	2.60	3.99	3.25	3.60
No. 16	2.70	4.09	3.35	3.70
Black				
Nos. 18 to 20	3.15	4.15	3.75	3.90
Nos. 22 to 24	3.20	4.20	3.80	3.95
Nos. 26 and 27	3.25	4.25	3.85	4.00
No. 28	3.35	4.35	3.95	4.10
Galvanized				
No. 10	3.60	4.35	4.25	4.25
Nos. 12 to 14	3.70	4.45	4.35	4.35
No. 16	3.85	4.60	4.50	4.50
Nos. 18 to 20	4.00	4.75	4.65	4.65
Nos. 22 to 24	4.15	4.90	4.70	4.80
Nos. 26 and 27	4.30	5.05	4.95	4.95
No. 28	4.60	5.35	5.10	5.25

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded.	53%	39%	55½%	43½%	54%	41%
2½ to 6 in. steel lap welded.	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameters Inches External	Diameters Inches Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft.:

Thickness Decimal	B.W.G. and Fractions	Outside Diameter in Inches ½	⅝	¾	⅞	1	1⅛	1¼
		Price per Foot						
.035″	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049″	18	.17	.18	.19	.20	.21	.23	.25
.065″	16	.19	.20	.21	.22	.23	.25	.27
.083″	14	.20	.22	.23	.24	.25	.27	.29
.095″	13	.21	.23	.25	.26	.27	.29	.31
.109″	12	.22	.24	.26	.27	.28	.30	.32
.120″ or .125″	11	.23	.25	.27	.28	.29	.31	.33
.134″	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	7.00	6.00@7.50	4.65†
Spring steel (heavier)	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.85	4.15
Cold rolled strip steel	6.35	6.35	6.80
Floor plates	5.55	5.60	5.50
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.20	3.10
Soft steel bars (base)	3.24	3.10	3.00
Soft steel bar shapes (base)	3.24	3.11	3.10
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.40	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	50@60%	55%	60%

Electric welding wire, New York, ⅛″, 8.25c.; ¼, 7.85c.; ⅛ to ½, 7.35c. per lb. *Flat, ⅛@¼-in. thick. †F.o.b. cars.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			15.12½
Tin, 5-ton lots, New York			65.00
Lead (up to carlots) E. St. Louis	9.10	New York	10.00
Zinc (up to carlots) E. St. Louis	8.70	New York	9.87½

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	23.50	21.25	20.00
Copper sheets, base	22.50	22.50	22.75
Copper wire, base	19.62½	16.50	16.50@16.75
Copper bars, base	22.12½	21.00	22.37½
Copper tubing, base	24.50	24.50	24.75
Brass sheets, base	19.12½	18.87½	19.37½
Brass tubing, base	23.75	23.50	27.37½
Brass rods, base	16.87½	16.62½	17.12½
Brass wire, base	19.62½	19.37½	19.87½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	28@29	28.00	28.03
Zinc sheets (casks)	12.00	12.60@12.95	12.27
Solder (½ and ½), (case lots)	40.25	41.00	38@42
Babbitt metal, delivered, New York, cents per lb.:			
Genuine, highest grade			80.62½
Commercial genuine, intermediate grade			56.00
Anti-friction metal, general service			31.50
No. 4 babbitt (f.o.b.)			14.50
Nickel, f.o.b. refinery, cents per lb.:			
Ingots 31 00 Electrolytic 38.00 Shot			32.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
Cold rolled sheets (base)			50 00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	12.12½@12.25	11.25	11.50@12.00
Copper, heavy, and wire	11.75@12.12½	11.50	11.25@11.75
Copper, light, and bottoms	9.00@10.75	9.50	10.00@10.50
Heavy lead	8.00@ 8.50	7.50	7.75@ 8.25
Tea lead	6.25@ 6.50	5.00	6.75@ 7.25
Brass, heavy, yellow	7.25@ 7.75	7.25	7.50@ 8.00
Brass, heavy, red	9.50@10.00	9.50	8.75@ 9.25
Brass, light	6.00@ 6.50	6.00	7.25@ 7.75
No. 1 yellow rod turnings	8.50@ 9.00	8.00	7.50@ 8.00
Zinc	5.00@ 5.50	4.75	5.00@ 5.50

TIN PLATES—American Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$11.25	$11.45	$11.50
"A" Grade:				
IC,	14x20	8.85	9.40	9 50
Coke Plates—Primes—Per box				
100-lb.,	14x20	6.45	6.10	7.00
Terne Plates—Small lots, 8-lb. Coating—Per box				
IC,	14x20	7.85	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.15@0.22	$0.19	$0.20
Cotton waste, colored, per lb.	.10@ .15½	.10	.17
Wiping cloths, washed white, per lb	.17	36.00 per M	.15½
Sal soda, per 100 lb. keg	2.25	2.25	2.75*
Roll sulphur, per 100 lb. keg	3.75	3.75	4.50
Linseed oil, per gal., 5 bbl. lots	.93¾	1.10	1.02
Lard cutting oil, 25% lard, per gal.	.55	.50	.54
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	.35	.35	.26
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–5%	40–5%	40–5%
Heavy grade	30–10%	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*In 175 lb. kegs.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.04	.0415	.0415
Brass rods	per lb	.1687½	.1737½	.1687½
Solder (½ and ½)	per lb.	.4025	.4025	.40@.41
Cotton waste	per lb.	.15@.22	.15@.22	14@21
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	6.50
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.55	3.55	3.38
Lard cutting oil	per gal.	.55	.55	.55
Machine oil	per gal.	.35	.35	.29
Belting, leather, medium	off list	40–5%	40%	40–2½%
Machine bolts up to 1x30 in.	off list	40%	40%	45%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.46	$5.84	$5.65
Emery paper	10.71	11.00	10.71
Emery cloth	29.48	31.12	29.48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.41	1.49
Cloth	3.55	2.67	3.20
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton		5.50@5.75
Coke, prompt foundry, Connellsville	per net ton		6.50@7.00
White lead, dry or in oil	100 lb. kegs	New York, 15.25	
Red lead, dry	100 lb. kegs	New York, 15.25	
Red lead, in oil	100 lb. kegs	New York, 16.75	

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1¼ and 1½x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x⅜in., $2.25 per 100, less 40%.

Tap bolts, 1½x¼-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ½x¼-in., 2c. each. Discount 70% for ⅛-in and smaller and 65% for ¼-in. and larger.
Case hardened ½x¼-in., 6c. each, less 50%.

Rivets, button heads, ¾-in., ½-in., 1-in. diam. x 2½-in. to 4½-in. $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, ⅞x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1¼ to 2-in. long, all diameters, 25c.; ¾-in. dia., 35c.; ½-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Washers, cast iron, ½-in., $7.00* per 100 lb. at New York warehouses; ¾-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Fla., Jacksonville — Ford Motor Co., Woodward Ave., Highland Park, Mich.—conveyors and general assembly plant equipment.

Ga., Macon — Willingham Sash & Door Co., 457 Third St.—wood sizer 12 x 18, No. 70.

Ill., Chicago—Niemann Table Co., 77 St. and Cottage Grove Ave.—planers, cut off saws, rip saws, shapers, band saws, glue jointers, turning lathes, trim saws, etc., all electrically driven for proposed 1 story, 125 x 575 ft. factory. Estimated cost $400,000 to $450,000.

Ill., Chicago—Northwestern Refrigerator Line Co., 19 South La Salle St., A. K. Engalls, Pres.—woodworking machinery including saws, planers, mortiser, etc., and metal working machinery for repairing refrigerator cars at Baraboo, Wis.

N. Y., Buffalo—Atlas Pattern Works, 854 West Ave., W. C. Faulks, Purch. Agt. equipment for the manufacture of wood and metal patterns.

N. Y., Buffalo—S. H. Horn, 488 Kensington Ave.—equipment for making glass enclosures, top repairing and trimming for automobiles

N. Y., Buffalo—J. Mink, 1326 Broadway (woodworking shop) — woodworking machinery.

O., Canton—Hercules Motor Corp., 140 Helliwell St. S. E., H. P. Blake, Secy.—new machinery for proposed 2 story addition to factory. Estimated cost $100,000.

O., Columbus—Bd. of Education, 270 East State St., E. H. Cope, Purch. Agt.—8 or 10 lathes 18 to 24 in., 2 shapers, 2 drill presses, one large and one small, Universal grinder, milling machine, whetstone grinder and other equipment for trade school departments of Central and South High Schools.

Tex., Robstown — E. McCaskill — additional planing mill equipment for recently acquired plant, cost to exceed $5,000.

W. Va., Wheeling — Wheeling Machine Products Co., E. W. Krause, Gen. Mgr.—4 spindle Acme automatic screw machine for the manufacture of pipe couplings, forging machines and upsetting machines (used).

Wis., Fond du Lac—L. Voell Auto Co., 24 East Division St.—repair machinery including lathe, drill press, air compressor, motors, etc., for proposed 1 story, 117 x 200 ft. garage and repair shop. Estimated cost $60,000.

Wis., Kenosha—Specialty Brass Co., 917 Lester St.—10 or 12 coke furnace for melting brass and moulding machines for 1 story foundry. Estimated cost $40,000.

Wis., Marinette—Standard Monument Co., 1418 Sherman St., F. W. Chase, Purch. Agt. power saws and polishers.

Wis., Milwaukee—Conway Co., 1819 St. Paul Ave.—special machinery, saws, presses, etc. for proposed 2 story, 200 x 200 ft. veneer plant to replace fire loss.

Wis., Sheboygan—Dillingham Mfg. Co., Wisconsin Ave. and South Water St.—additional woodworking machinery for proposed 3 story, 40 x 80 ft. and 34 x 80 ft. addition to factory for the manufacture of furniture and household refrigerators.

Wis., Waukesha—C. A. Gorder, 234 West Main St.—sheet metal working machinery.

Ont., Niagara Falls—City, T. S. Scott, City Hall, engr.—lathe and drill, electric drive, for municipal paving plant.

Opportunities for Future Business

Calif., Corona—City plans an election to vote $150,000 bonds for the construction of shops, etc. at new high school and to remodel Washington school.

Calif., Los Angeles—J. H. Jonas, 4161 La Salle Ave., awarded contract for the construction of a 3 story, 60 x 180 ft. addition to furniture factory at 5841 South Park Ave. Estimated cost $60,000.

Calif., San Francisco—Electric Storage Battery Co., 1536 Bush St., awarded contract for the construction of a 1 and 2 story factory at 3rd St. and Paul Ave. $125,000.

Calif., San Francisco — J. Pasqualetti, Humboldt Bank Bldg., awarded contract for the construction of a 6 story garage at Stockton and Green Sts. $155,000. Noted Dec. 3.

Calif., Van Nuys—Bd. of Education, Los Angeles, will receive bids until Jan. 13 for the construction of a 1 and 2 story high school including a 72 x 223 ft. manual arts building, etc., here. Estimated cost $150,000. O. Neher, Insurance Exchange Bldg., Los Angeles, Archt. Noted July 23.

Conn., Derby—Derby Gas & Electric Co., 22 Elizabeth St., will soon award contract for the construction of a 3 story, 41 x 65 ft. shop on Housatonic Ave. Estimated cost $50,000. R. W. Foote, 185 Church St., New Haven, Archt. Noted Nov. 12.

Conn., Waterbury—Lux Clock Mfg. Co., 97 Sperry St., is receiving bids for the construction of a 5 story, 50 x 322 ft. addition to factory. T. M. Freney, 51 Leavenworth St., Archt. Noted Nov. 5.

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BUSINESS NEWS DEPARTMENT
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10th Ave. at 36th St., New York.

Fla., Jacksonville — Ford Motor Co., Woodward Ave., Highland Park, Mich., plans the construction of a 1 story, 206 x 239 ft. addition to auto assembly plant at Atlantic Coast Line and St. Johns River here. A. Kahn, 1000 Marquette Bldg., Detroit, Mich., Archt.

Ill., Chicago—Cinch Mfg. Co., 2339 West Van Buren St., awarded contract for the construction of a 2 story, 65 x 125 ft. factory for the manufacture of fasteners for automobile curtains. Estimated cost $50,000.

Ind., Evansville—Graham Bros., Stringtown Road, awarded contract for the construction of a 3 story truck factory. Estimated cost $90,000.

Md., Baltimore—Autocar Sales & Service Co., 1309 Cathedral St., awarded contract for the construction of a 1 story, 115 x 300 ft. garage and service station at 27th and Sisson Sts. Estimated cost $150,000.

Mass., Chelsea (Boston P. O.)—J. Seeley Co., 115 Park St., is receiving bids for the construction of a 1 story repair and service garage on Pearl St. Estimated cost $40,000. S. S. Eisenberg, 46 Cornhill, Boston, Archt.

Mass., Dorchester (Boston P. O.) — J. T. Beckwith, 7 Rock Hill Ave., is having preliminary plans prepared for the construction of a 1 and 2 story repair and service garage. Estimated cost $50,000. C. G. Loring, 7 Water St., Boston, Archt.

Mass., Dorchester (Boston P. O.)—L. Cavagnaro & Sons, 18 Washington St., plans the construction of a 2 story addition to repair and service garage. Estimated cost $75,000. G. E. Robinson, 80 Federal St., Boston, Archt.

Mass., Newton Center (Boston P. O.) — N. Applegard awarded contract for the construction of a 1 story, 119 x 174 ft. repair and service garage at 782 Beacon St. Estimated cost $60,000.

Mass., South Boston (Boston P. O.)—A. Ketnes, 58 Champney St., awarded contract for the construction of a 1 story, 50 x 70 ft. auto repair shop. Estimated cost $40,000.

Mass., Worcester—P. Power, 33 Prescott St., is receiving bids for the construction of a 1 and 2 story work shop and repair garage. Estimated cost $40,000. H. L. Meacham, 120 Front St., Archt.

Mich., Detroit — Chrysler Motor Corp., awarded contract for the construction of a 1 story, 286 x 820 ft. factory. Estimated cost $400,000.

Minn., St. Paul—Motor Power Equipment Co., 2512 University Ave., awarded contract for the construction of a 1 story, 100 x 300 ft. factory. $100,000. Noted May 28.

Miss., Jackson—The American Gear & Mfg. Co., plans the construction of a 187 x 250 ft. machine shop.

Mo., St. Louis—Standard Oil Co. of Indiana, Jefferson and Locust Sts., awarded contract for the construction of a 1 story, 114 x 150 ft. machine shop on Folsom St. Estimated cost $60,000.

Neb., South Sioux City—Chicago, Burlington & Quincy R.R. Co., 547 West Jackson Blvd., Chicago, Ill., plans the construction of addition to round house and repair shop here. A. W. Newton, Ch. Engr.

N. Y., Buffalo—The Barber Asphalt Co., Land Title Bldg., Philadelphia, Pa., awarded contract for the construction of a 1 story, 45 x 225 ft. machine shop here. A. L. Bell Mgr. Buffalo Wks.

N. Y., Port Richmond—Proctor & Gamble Co., Western Ave., awarded contract for the design and construction of 2 additional buildings with furnace and generator building for hydrogen gas equipment to H. K. Ferguson Co., 4900 Euclid Avenue Bldg., Cleveland, O. Estimated cost $150,000.

O., Canton — H. J. Eberman, 431 Tuscarawas St., plans to purchase site for the construction of a 1 story fabricating steel factory. Estimated cost $100,000.

O., Cleveland—The Newburg Steel Co., S. Friedman, Secy., 6932 Kinsman Road, is having preliminary plans prepared for the construction of a 3 or 4 story factory for the manufacture of sheet metal products for automobiles on Collamer Ave. Estimated cost $400,000. Architect not selected.

O., Columbus—Dept. of Welfare, Ninth and Oak Sts., J. E. Harper, Dir., will receive bids until Feb. 1 for coal handling equipment; conveyor 50 ton per hr., 60 ft. long and a crusher 50 ton per hr., for proposed Cleveland State Hospital, Cleveland.

Pa., Newell — Pittsburgh & Lake Erie R.R. Co., Pittsburgh & Lake Erie Terminal Bldg., Pittsburgh, awarded contract for the construction of a 1 story, 35 x 150 ft. car repair shop here. Noted June 4.

Pa., Philadelphia—P. S. Tyre, 114 South 15th St., Archt., will receive bids until Jan. 12 for the construction of an 8 story sales and maintenance building at Broad, Ridge Ave. and Mellon and Patts Sts. for Cadillac Motor Car Co., J. J. Greenberg, Morris Bldg. Estimated cost $500,000.

Pa., Philadelphia—John W. Watson Co., 24th and Locust Sts., plans the construction of a 1 story, 124 x 783 ft. plant for the manufacture of auto accessories, etc., at Aramingo Ave. and Tulip and Sanger Sts. Estimated cost $300,000. Ballinger Co., 12th and Chestnut Sts., Archt.